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I. C. Russell

ON THE

ORGANIZATION OF SCIENTIFIC WORK

OF THE

GENERAL GOVERNMENT

BY

JOHN W. POWELL
DIRECTOR OF THE U. S. GEOLOGICAL SURVEY

PART 2—ADDITIONAL STATEMENTS

Extracts from the testimony taken by the Joint Commission of the Senate and House of Representatives to "consider the present organizations of the Signal Service, Geological Survey, Coast and Geodetic Survey, and the Hydrographic Office of the Navy Department, with the view to secure greater efficiency and economy of administration."

WASHINGTON:
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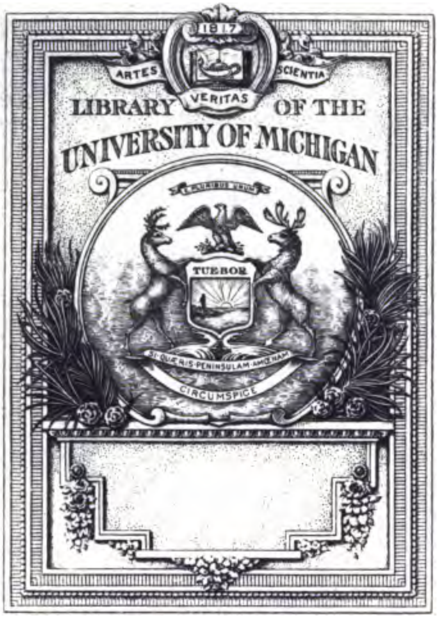
1886.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STATEMENT OF THE DIRECTOR OF THE GEOLOGICAL SURVEY.

The Director of the Geological Survey, Major POWELL, was called upon and made statement as follows:

Mr. CHAIRMAN AND GENTLEMEN OF THE COMMISSION: Before proceeding in reply to your written interrogatories, I ask for a few minutes in which to make a preliminary statement somewhat in reply to the papers just read before you.

The CHAIRMAN Take your own time, Major Powell, and proceed in your own manner.

Major POWELL proceeded: In previous statements made by me before the Commission, I have taken some care to show my interest in and appreciation of the work of the Coast Survey, both in the preparation of coast charts for the use of the mariner and also in the conduct of its geodetic work, and I have endeavored to make such arguments in favor of that work as opportunity would permit. On the other hand, I hav tried to show that the system of topography adopted for coast cha was not the proper system for the interior of the country, and in connection with the statements which have just been made to the Commission I beg to reiterate, in very brief manner, the reasons why such a topographic system would be unwise.

Mr. Colonna states, confirming my previous estimate to the Commission, that such topography would cost at least $100 per square mile. The area of the United States, including Alaska, is three and a half million square miles, and a map of the United States constructed on such a plan would therefore cost $350,000,000. These bare statements show that it would be utterly unwise to attempt such an enterprise.

Again, if the map were constructed on such a scale, its utility to the people would be very little, because of its unwieldy proportions. Four hundred thousand sheets would be required for such a map, and the atlas would be a library of 8,000 large folio volumes.

Again, I think I have clearly shown that the topographic system adopted, because of the amount of cultural features presented thereon, would speedily become obsolete, so that every few years a resurvey would become necessary; and the maintenance of such a map would cost many millions of dollars annually.

Again, I think that I have shown to the Commission that the features usually shown upon the coast charts are not such as should be shown upon a map of the interior; that the cultural features should be largely omitted, and that the natural features should be more clearly delineated in order that the map may serve the best purposes.

Again, I have shown to the Commission that the scale for the interior map adopted by the Geological Survey is substantially the same, or nearly the same, as that adopted by other civilized countries; that the experience of all Europe, after the expenditure of hundreds of millions of dollars, has clearly demonstrated that maps of about the scale adopted in the United States are most useful and practicable. The scale in France for the general topographic map is 1:80,000; Great Britain, 1:63,000; India, 1:253,000; Germany, 1:100,000; Russia, 1:126,000; and so on. In the United States the scale is 1:62,500 for some parts of the country, 1:125,000 for other parts, and 1:250,000 for still other parts, the scale varying for reasons heretofore set forth. The vast experience of the world in this matter ought to be of some value to us.

In the letter read from Mr. Dana it is shown that in his opinion there are regions where the map should be made upon a scale of 2 inches to the mile, in order that the field geologist may plot thereon the features which he desires to represent. It is a singular coincidence that this is the scale practically adopted for that part of New England by the Geological Survey. I have already explained that in the field the maps are originally constructed on twice the scale published—that is, when they come to be engraved on copper they are reduced one-half—and I have also explained to the Commission that the field geologists are usually put in possession of maps on the larger scale before reduction. Moreover, I have explained that there are some districts where the geology is so complex that special maps are necessary for the delineation of the geologic features.

Mr. Colonna has told you that the maps of the Geological Survey were constructed with grade curves, *i. e.*, contour lines, with vertical intervals of 200 feet, and then told you that such grade curves were entirely inadequate to represent the topographic features of a country like, for example, the District of Columbia. This statement is misleading. It is true that in the great mountain region of the far West contour lines *with 200 feet* intervals are used, but they are quite adequate to express the topography of the mountains and all that is necessary or practicable to be used in delineating mountains. There are indeed cañon cliffs where vertical intervals of 500 feet, and some where vertical intervals of 1,000 feet must be used to represent the topography, it being practically impossible to represent these intervals with a greater number of contours because of the steepness of the walls. I have already fully explained to the Commission that the contour lines are adapted to the character of the topography; that in a region of country like the District of Columbia grade curves of 20 feet interval are used; that on the low coasts of New Jersey grade curves of 10 feet interval are used; and that everywhere the curves are adapted to the topography. It is unfortunate that Mr. Colonna should not have read my former statement or at least have informed himself of the actual method of constructing maps in the Geological Survey.

Mr. Colonna also stated that in the Geological Survey the contour lines are sketched, and that in the Coast Survey contour lines are actually run upon the ground. I suppose he means that in the 'Geological Survey points are established at varying distances apart, and that the contour lines are run by the eye from point to point. This is true in the Geological Survey; it is also true in the Coast Survey. In the Coast Survey charts and in the Geological Survey charts alike, contour lines are run by such methods. I hope Mr. Colonna does not suppose that the Coast Survey runs actual lines of level upon the ground.

Mr. COLONNA. Oh, no; not in the ordinary work, but in the District work.

Major POWELL. That is a very different affair. The map made of the District of Columbia is made for the city engineers, that they may determine the filling and grading of streets and the excavation necessary for sewers, and for other purposes of like character. Should we attempt to make a general topographic map of the United States upon such a plan, the cost would be many billions of dollars, and the map would be composed of many million sheets. The Geological Survey is not engaged in any such work.

Mr. COLONNA. I beg pardon. The lines in Coast Survey work are leveled by the plane-table. We do not depend on the barometer for such work.

Major POWELL. I am coming to that. If the gentleman had taken pains to read my testimony, he would have seen that the barometer is not used for running levels in a low, flat country like that of New Jersey or the District of Columbia; that the barometer is used in high mountain regions; that instead of running a line of levels upon a mountain side, we use the barometer in conjunction with dip angles for the determination of mountain peaks, for economy's sake; and that the altitudes measured in this manner are sufficiently accurate for all map-making purposes, and for all other practical purposes; and that to run actual lines of levels over mountain ranges would be a most foolish and atrocious waste of money. In the conduct of a great survey like that in which we are engaged, extending over a vast area of country, we try to adopt the best methods for the several localities, and it is quite unfair to take the methods which we use in high mountain regions and show that they are not adapted to low coast regions, and then claim that such is the work of the Geological Survey.

Again, Mr. Colonna states that the triangulation of the Geological Survey is done by sighting at the tops of hills. Had he read my statements made to this Commission, or had he read the reports of the Geological Survey, he would not have made such a statement. In the triangulation carried on by the Geological Survey artificial points are used, usually monuments of stone erected around a pole, the pole itself being the objective point to which the instrument is directed. The difference between the Coast Survey methods and the Geological Survey methods in this respect is this: The Coast Survey usually employs the heliotrope, the Geological Survey monuments with signal poles. For topographic purposes our method is all that is necessary, and is by far the most economic, but for geodetic purposes the more expensive Coast Survey method is the proper one.

Mr. COLONNA. In other words, Major Powell is elaborating, just as I have said, in fact, they would have to do; that they commence with rough work, and elaborate until they carry the work through to the refinement which we use in the Coast Survey, as nearly as they can.

Major POWELL. I think the statements which I have made to the Commission very clearly show what we do in this matter, and what we do not do.

Mr. Colonna has also made some statements relating to the plane-table. I have very little to say on this point. It is a question of minor detail, this question of the best method of using the plane-table. In all topographic work methods are adapted to conditions, and hence methods vary; but just under what condition one method is better than another is always a question of nice distinctions. If Mr. Colonna will come to the office of the Geological Survey, he will find there a score or two of topographers who will debate that question with him, some perhaps agreeing with him, and others disagreeing; and I am inclined to believe, Mr. Chairman, that if a score of topographers of the Coast Survey were to discuss these points, they would develop many minor disagreements. Such a subject is hardly worth the time of the Commission. It is purely a technical question relating to minute details of work.

I have brought with me this morning some sheets of the map, which I wish to place before the Commission. When before you last summer I stated that the cartographic system was yet not fully complete; that some points were yet undetermined. The system has at last been perfected—that is, we have adopted a system which seems to be the best, so far as we can judge. We have been improving from time to time, and, as Mr. Colonna says, in some of these improvements we increase the expense, though in the main the improvements are in the direction of greater simplicity and economy, and this greater simplicity is a substantial improvement in the chart itself, as I have already explained, besides conducing to very great economy. The work in the field is diminished; the vast details of private culture being neglected, greater care can be devoted to natural features, and the work in that respect may be made better, and all at a great saving of expense; and when the map is once constructed it has permanent value, while, if the facts of private culture were represented, the work would have to be renewed from time to time. Since I was last before you we have found that experiments made in the regions of the prairies and great plains are eminently successful, and that the work of constructing a topographic map over all the region—perhaps more than one-fourth of the United States—will be less expensive than we at first estimated. This results from the fact that we can to some extent utilize the work of the Land Office, *i. e.*, the parceling surveys of the Land Office, and from the consequent fact that all of that district is laid out in squares and parallelograms, and so outlined by fences and roads, in straight lines crossing at right angles, whereby the work is rendered less difficult than in a region where all the cultural lines of the surface are curves.

[Major Powell then exhibited the scheme of conventional signs to the Commission.]

By the CHAIRMAN:

Q. These are the topographic signs which govern the construction of your standard map?

A. Yes, sir.

Q. Have you a map already made having these signs?

A. Yes, sir; I have a few sheets here to show you. [The charts were exhibited to the Commission.] I beg you to compare the grade-curve system exhibited in these sheets with that of the curve and culture system of the Coast Survey charts, which are also before you on the table. In the Geological Survey sheets mountains, hills, and valleys are exhibited; also the streams, roads, townsites, &c., while all private culture is neglected. On the Coast Survey charts you will see that a large body of private culture is represented, and thus the natural topography of the country and the public culture of the country are greatly masked.

Mr. COLONNA. Gentlemen, you will observe that the engraving is the work of the photo-lithographer; he has produced the picture; as to the actual work upon which the map is based, for that you must appeal to the civil engineer and the work that has been actually done in the field.

Major POWELL. The map is not photolithographed; it is engraved on copper; the hypsography on one plate, the public culture on another, and the hydrography on a third; and each map has to go through three processes of printing in three different colors, the water being in blue, the hill features in brown, and the public culture in black. Only thirteen of these maps have been thus printed as an experiment, and I am not yet quite ready to say what the engraving will cost.

Mr. COLONNA. Major, you do not say that one of these contours has the same value that ours have?

Major POWELL. This chart is in a mountain region where the peaks reach to an altitude of 10,000 to 12,000 feet. The grade curves have intervals of 200 feet, and the map is on a scale of 4 miles to the inch, and they have all the accuracy that is demanded and that can be utilized on such a map.

Mr. COLONNA. The Stansbury Mountain is sketched in from how many stations?

Major POWELL. Perhaps from twenty or thirty.

I think, Mr. Chairman, that it would not be wise to go on with an interlocutory statement about details of this nature; I think that nothing of value to the Commission would be elicited thereby.

The CHAIRMAN. I think it would be better for Major Powell to continue his general statement.

Major POWELL. I think that the principal officers of the Coast Survey would not disagree with me materially in any of the statements which I have made.

By Mr. HERBERT:

Q. Do these lines [indicating] represent latitude and longitude?

A. Yes, sir.

Q. They represent degrees, I suppose?

A. Half degrees; that is, they are projection lines 30 minutes apart.

By Mr. LOWRY:

Q. That estimate of $100 to the square mile was upon the assumption that by either system a complete survey of the entire surface of the country was to be had?

A. Yes, sir; that is, if charts were made like those of the Coast Survey they would average $100 for every square mile of the country; if made by the method of the Geological Survey they would vary from $1.50 to $10 per square mile.

By Mr. HERBERT:

Q. But is it contemplated under either the Geological Survey system or the Coast Survey system to make a map of the entire country?

A. It is contemplated by the Geological Survey to make a topographic map of the entire area of the United States, and such a map will be composed of many sheets such as I have shown you. I think it is proposed in the Coast Survey to make charts of the coast on their plan, but not to extend such topography into the interior, though Mr. Colonna seems to think that such a system of topography should be extended over the entire country. The entire coast will probably be surveyed as the Coast Survey has been doing, and the entire country should be covered with a system of geodetic figures, as the Coast and Geodetic Survey is now doing the work; while the entire country should be covered with a topographic survey as the Geological Survey is now doing the work; and the topographic survey should precede the geodetic and the geologic surveys for economic reasons and for all other reasons.

I believe, Mr. Chairman, I have nothing further to say on this part of the subject, and will proceed with my answers to your written interrogatories.

Recess was then taken until 1.30 p. m.

The Commission reconvened at 1.30 p. m.

The CHAIRMAN. Professor Powell, will you now proceed with your statement?

Major POWELL [reading]:

DEPARTMENT OF THE INTERIOR,
UNITED STATES GEOLOGICAL SURVEY,
Washington, D. C., December 17, 1885.

Hon. W. B. ALLISON,
Chairman Congressional Joint Commission, Washington:

SIR: In reply to your request for information relating to certain operations of the Geological Survey, I have the honor to make the following statements:

(1) A statement relating to the method of transacting business in the Geological Survey.

(2) A statement relating to the publications of the Geological Survey.

(3) A statement relating to the scientific experts employed by the Geological Survey not upon its regular force.

(4) A statement showing the distribution of the employés of the Geological Survey to the different fields of work through the United States. This shows the distribution of all employés except those provided for in the legislative bill, who constitute the office force of accountants and clerks.

I am, with great respect, your obedient servant,

J. W. POWELL,
Director.

ON THE TRANSACTION OF THE BUSINESS OF THE GEOLOGICAL SURVEY.

When originally called before the Commission I had anticipated that I should be required to explain the business management of the Geological Survey, and was therefore quite unprepared for the line of investigation which the Commission pursued. I am exceedingly grateful to the Commission for this opportunity of explaining the business management of the Survey, for to that department of administration I have devoted much time and thought, and have gradually developed a business system which I think reasonably meets the requirements.

The operations of a scientific Bureau like that of the Geological Survey may be divided properly into two departments, viz, scientific operations and business operations. The purpose for which the Bureau is organized is the prosecution of scientific research; but in carrying on these operations money is expended in the payment of salaries and wages, and property is acquired, because the materials of investigation are necessary; and further, property is produced, as reports, maps, &c., which must be distributed to the general public. Success in the administration of such a Bureau, therefore, does not depend wholly upon wise administration in scientific operations, but is equally dependent upon wise administration of business affairs. The field of investigation is boundless; the extent to which this field may be cultivated is limited by the amount of money appropriated for that purpose. To whatever extent the scientific administration is unwise, scientific results will be fruitless, and the sums appropriated may be partly or wholly wasted thereby; to whatever extent the business operations are unwisely managed, to that extent the output of work is decreased. On former occasions I have endeavored to lay before the Commission the method of administering the scientific operations of the Geological Survey.

In setting forth the business operations of the survey, I shall first explain the fiscal system, *i. e.*, the methods and regulations relating to disbursements; second, the custodial system, *i. e.*, the method of preserving and accounting for the property acquired by the survey; and, third, the method of distributing and accounting for the publications of the survey.

FISCAL SYSTEM.

In the disbursement of the money appropriated for the Geological Survey there are four fundamental considerations involved: (1) Every facility should be rendered to the conduct of the scientific work of the survey, as that is the purpose for which the money is appropriated; (2) there should be no unnecessary or extravagant expenditure; (3) the public money should be protected against depredation, and (4) every Government agent should be required to establish the integrity of his transactions.

It is evident that exclusive attention to the facilitation of the work might lead to extravagance, while a parsimonious policy might impede the work by depriving it of the necessary facilities. Proper administration demands the exercise of discriminating judgment in each individual case.

Every restrictive regulation to prevent extravagance and fraud adds to the labor of those engaged in research, adds to the amount of clerical work to be performed, and to some extent obstructs and delays the performance of scientific work. It is quite possible so to complicate the fiscal and custodial systems of a bureau that its conduct shall consume a large part of its energy and correspondingly diminish its scientific results.

It is, moreover, a familiar fact that regulations for the prevention of dishonest practices, while they are designed to conserve the means for the conduct of the proper work of the bureau, are in themselves a source of expense. Protection from depredation costs money.

The relation of the disbursing agent to the Government differs in an important respect from the relation between a private business agent and his employer. In the latter case, the employer is an individual, having a personal interest in the business transacted and a personal acquaintance with his agent. In the former case the employer is impersonal, and cannot directly supervise the transactions of the agent. The disbursing agent is, therefore, essentially a trustee, and the funds in his charge are trust funds; so that it is not without reason that he is required to submit to a system of restrictive regulations, which, in ordinary commercial business, might be regarded as onerous. The private employer assumes the integrity of his agent until the contrary is proved; the Government requires its agents to establish the integrity of all their transactions.

The administrative problems thus indicated have been the subject of much thought and patient experimentation, and it is believed that a fairly good practical solution of the problem has been reached by the adoption of the system now to be set forth.

A bureau whose function is scientific research has this prime characteristic: Its scientific assistants perform their labors *con amore*, and are actuated by personal aspirations and ambitions to the accomplishment of a maximum amount of work. With those who have been initiated into the arcana of discovery, research becomes a passion. To utilize this trait of character it is necessary, first, that the proper scientific experts should be selected, and this is the most important duty devolving upon the head of a scientific bureau; second, in order that the whole body of men engaged in research may be imbued with this spirit and actuated by high scientific motives, it is necessary that each man doing original work should be properly credited with the results of his work in the publications of the Survey. Thus every man becomes an author, and is responsible to other scientific men and to the intelligent world at large for his scientific statements. Keeping these principles in view, the Director has gathered into the Survey, as far as possible, the most able scientific men of the country, and every man is an author, actual or prospective.

Whatever line of investigation may be taken up by the scientific expert, a greater or less expenditure is involved; and if a definite, reasonable amount of money is allotted therefor, the investigator may be depended upon to administer the details of expenditure with a degree of wisdom and economy superior to that of a person who is but perfunctorily engaged in the work for its emoluments.

A portion of the money appropriated for the Geological Survey is assigned by law to the payment of certain stated salaries. The specification of these salaries in the appropriation bills has been made at the request of the Director. It is self-evidently wise that the most able geologists, chemists, astronomers, and geographers of the country should be employed. In order to secure their services reasonable salaries must be paid, and the Director did not wish to carry the burden of responsibility involved in the designation of the higher salaries without direct statutory authorization. In addition to the amount appropriated for specific salaries, a large sum is assigned by the Director, with the approval of the Secretary of the Interior, to the payment of certain other salaries. The remainder applies to the general expenses of the work.

The Director organizes the force of the Survey into parties, each party being composed of a chief and his assistants, and allots to each such party or division the money necessary to pay the salaries specified by law or designated as above described, and also to pay the general expenses of the party in the prosecution of its work; that is, the money appropriated for the use of the Geological Survey is divided into parts and allotted to the divisions of the Survey.

Now, the work of the Survey is of such a character that it cannot be fully specified and planned in advance, from the fact that to a large extent it is research for facts and principles not yet discovered. But this condition obtains to a different degree in the several parts of its work. In topography the mapping of a special district may be laid out in advance with some degree of detail; but in all the other lines of research only the general object in view and the general line of investigation to be pursued can be designated, and the details of the work must be left to be governed by the conditions that arise from time to time in its prosecution.

To exhibit more clearly the method by which the allotments are made and the general plan of the work outlined in advance, I think it would be well to set before the Commission the plan presented by the Director to the honorable the Secretary of the Interior for the operations of the Survey during the present fiscal year, and approved by him. The following is a copy of such plan:

DEPARTMENT OF THE INTERIOR,
UNITED STATES GEOLOGICAL SURVEY,
Washington, D. C., June 23, 1885.

SIR: I have the honor to submit the following plan of operations for the Geological Survey, to extend through the fiscal year ending June 30, 1886, and respectfully request its examination and approval by the honorable the Secretary of the Interior.

I am, with respect, your obedient servant,

J. W. POWELL,
Director.

The Hon. the SECRETARY OF THE INTERIOR.

GEOGRAPHY.

There is transmitted herewith a map of the United States, upon which the areas heretofore surveyed are colored in gray, and the areas which it is proposed to survey during the coming year are colored in yellow.

It is recommended that for the salary and expenses of the chief geographer, Mr. Henry Gannett, and his assistant, Mr. J. A. Maher, there be allotted the sum of $4,200.

New England section.

It is proposed to continue work in Massachusetts, and to employ five topographic parties to operate in different portions of the State. The chief geographer, Mr. Henry Gannett, will have charge of this work, assisted by the following persons: C. C. Bassett, S. H. Bodfish, Charles Dür, James H. Jennings, Willard D. Johnson, Anton Karl, E. W. F. Natter, R. H. Phillips, and H. F. Walling.

The agreement under which the Commonwealth of Massachusetts co-operates in this work was fully set forth in the plan of operations submitted for the fiscal year ending June 30, 1885. Under its terms the sum of $15,000 will this year be applied by the State for the prosecution of the survey, and it is recommended that on the part of the Geological Survey there be allotted for its continuation the sum of $18,000.

New Jersey section.

It is proposed to continue topographic work in New Jersey under the general supervision of Prof. George H. Cook, the State geologist, with Mr. C. C. Vermeule, topographer, in charge.

It is recommended that for the needs of this work there be allotted the sum of $12,000.

Appalachian section.

It is proposed to continue the survey in this region, and to assign to the work seven parties—one for triangulation and six for topography. The following is a general synopsis of the plan to be adopted:

To continue the survey in the northern part of Virginia and West Virginia; to extend the survey of the Blue Ridge and Great Valley northeastward into the southwestern part of Virginia; to extend the area of work into Eastern Kentucky; to complete the survey of the Great Valley in East Tennessee, and to extend the work southward into Georgia; to complete the survey of the mountain region of North Carolina, and extend the work to Northern Georgia, and to survey certain detached areas in North Carolina east of the Blue Ridge, for the purpose of completing atlas-sheets; and to survey the square degree in Northern Alabama between longitudes 87° and 88° and latitudes 34° and 35°.

Mr. Gilbert Thompson will be assigned to this work, as geographer in charge, to be assisted by the following persons: Jeremiah Ahern, E. C. Barnard, Morris Bien, H. B. Blair, P. H. Christie, L. C. Fletcher, S. S. Gannett, W. T. Griswold, M. Hackett, John W. Hays, J. D. Hoffmann, J. D. Howell, F. J. Knight, R. C. McKinney, R. McC. Michler, A. E. Murlin, Louis Nell, E. A. Oyster, F. M. Pearson, H. S. Selden, R. M. Towson, S. J. Wilson, and C. M. Yeates.

For the prosecution of this work it is recommended that there be allotted the sum of $58,000.

Missouri-Kansas section

It is proposed to continue the survey of these two States, substituting a belt of triangulation for astronomic locations. The force will consist of three parties, one triangulation and two topographic. The region to be surveyed lies between latitudes 38° and 39° and longitudes 93° and 97°, to which will be added the area uncompleted last year lying between latitudes 37° and 38° and longitudes 96° and 97°.

Texas section.

It is proposed to send to this State one triangulation party and two topographic parties to complete the square degree lying between latitudes 30° and 31° and longitudes 98° and 99°, and to make up the square degree lying between latitudes 31° and 32° and longitudes 98° and 99°.

Arizona section.

It is proposed to reduce the force operating in this division to one topographic party, which will survey the two square degrees lying between latitudes 34° and 35° and longitudes 111° and 113°, and extending into a portion of the division of the Great Basin.

Gold belt section.

In view of the Geological Survey investigations to be commenced in the gold belt district, it is proposed to send two topographic parties to this region. The area to be covered lies between latitudes 39° and 40° and longitudes 120° 40′ and 122°.

Cascade section.

It is proposed to continue the survey of this district, the field of operations being in California, and extending as far northward as the Oregon line. Two parties are assigned to the work.

It is proposed to assign Prof. A. H. Thompson to the foregoing work, as geographer in charge, to be assisted by the following persons: H. L. Baldwin, R. H. Chapman, A. P. Davis, E. M. Douglas, A. F. Dunnington, C. H. Fitch, R. U. Goode, Paul Holman, George T. Hawkins, Mark B. Kerr, E. T. Perkins, jr., W. J. Peters, E. Ricksecker, H. C. Rizer, H. S. Wallace, and H. M. Wilson.

It is recommendod that for all the topographic work under Professor Thompson there be allotted the sum of $58,500.

Yellowstone section.

It is proposed during the coming field season to complete the unsurveyed portions of the Yellowstone National Park, and for this purpose an increased force will be used.

It is proposed to assign to this work Mr. J. H. Renshawe, as geographer in charge, assisted by the following persons: Stephen A. Aplin, William H. Leffingwell, and Frank Tweedy.

In addition to the completion of the Park, it is expected that the survey will be extended southward as far as latitude 44°.

It is recommended that there be allotted for the prosecution of work in this district the sum of $12,000.

Section of topographic drawing.

For preparing in the office maps ready for the engraver and for revision from time to time, and for proof-reading the same, the following persons will be employed, under the supervision of Mr. Harry King: M. A. Cudlipp, Franz Fiset, John H. Klemroth, E. V. McElhone, and Albert Noerr.

It is recommended that there be allotted for this work the sum of $6,140

Astronomic section.

It is proposed to determine the latitude and longitude of a number of fundamental points to be hereafter selected. In this work there will be employed the following persons: R. S. Woodward and B. C. Washington.

It is recommended that there be allotted to this work the sum of $2,600.

Instruments.

For the repair of instruments and for the purchase of such additional ones as may be needed from time to time, for the purchase of maps, and for the salary of Mr. Edward Kübel, mechanician, it is recommended that there be allotted the sum of $6,350.

The total amount recommended in the foregoing statement for geographic work is $177,790.

GEOLOGY.

Archæan division.

It is proposed to continue the study of the Archæan formations in New England, and to push the work as far southward as its development demands. Prof. Raphael Pumpelly will remain in charge of these investigations, and will be assisted by Bayard T. Putnam, and Alex. O'D. Taylor.

It is recommended that for this work there be allotted the sum of $14,000.

Atlantic coast division.

It is proposed to continue researches upon the geology of the Atlantic coast of the United States, which work will be carried on under the direction of Prof. N. S. Shaler. It is recommended that there be allotted for this work the sum of $3,500.

Appalachian division:

It is proposed to continue the geologic investigations in this district, the work to remain under the immediate direction of Mr. G. K. Gilbert, with the following corps of assistants: E. H. Andrews, I. C. Russell, Ira Sayles, I. C. White, H. R. Geiger, J. H. Safford, Robert Stein, and Bailey Willis.

The plan of investigation contemplates the study of the terrace system of the Atlantic drainage in Virginia and the Carolinas, with a view to its ultimate correlation with the terraces of the level-line deposits of the coast; the examination of the Triassic areas of the Piedmont region; the study of the disturbed Paleozoic rocks south of the Pennsylvania line, including the construction of sections and stereograms, and a general study of the geology of West Virginia south of the Kanawha, as well as of certain areas in Virginia and the portion of Maryland adjacent thereto, and Kentucky north of Cumberland Gap, and extending southeastward across portions of Tennessee and North Carolina.

It is recommended that there be allotted for this work the sum of $21,000.

Lake Superior division.

It is proposed to continue the study of the geology of the Lake Superior region, including the correlation of the crystalline rocks of this district to those of other parts of the United States.

Prof. Roland D. Irving will be assigned to this work, assisted by the following gentlemen: W. M. Chauvenet, C. W. Hall, C. R. Van Hise, W. W. Daniells, W. M. Merriam, and George H. Williams.

For the prosecution of this work it is recommended that there be allotted the sum of $10,000.

Glacial division.

It is proposed to continue the study of the glacial geology of the United States, extending from the Atlantic to the Rocky Mountains. Prof. T. C. Chamberlin will be assigned to this work, assisted by the following gentlemen: R. D. Salisbury, J. E. Todd, G. H. Stone, Warren Upham, and G. F. Wright.

For this work it is recommended that there be allotted the sum of $9,500.

By Mr. MORGAN:

Q. What is your definition of glacial geology?

A. There is a geological formation of clay, sand, and gravel extending over a very large area in the United States, usually called the glacial drift. This formation is from a few feet to 300 feet in depth, and constitutes the general surface of the country where it is found. The region in which it is found lies north of the Ohio River, and extends northeastward from there to the foot of Long Island Sound in an irregular line, and northwestward to the Rocky Mountains. It thus stretches from the Atlantic to the Rocky Mountains, and reaches to the northern line of the United States, and beyond into British America. The study of this formation is called glacial geology.

Q. Geologists agree that this is the work of glaciers in advancing across the continent?

A. Such theory is very generally accepted.

By Mr. HERBERT:

Q. That theory is disputed, is it not?

A. I can hardly say that it is disputed by competent authorities. Mr. Donnelly, in a kind of geological novel bearing the same relation to geology that Jules Verne's romances bear to astronomy and physics, ascribes the origin of this material to the striking of a comet upon the earth; but geologists, I believe, everywhere are agreed that the formation is due to the action of ice. There is some little disagreement as to the extent to which ice as glaciers and ice as icebergs has taken part in the work, but it may be said that there is a practical consensus of opinion among working geologists that ascribes the whole or the greater part of it to the action of accumulated snow and ice in vast systems of glaciers.

Montana division.

It is proposed that Dr. F. V. Hayden, assisted by Dr. A. C. Peale, shall continue the study of the geology of the region of the Upper Missouri River, and its relations to the geology of the district extending northward into British America.

For this purpose it is recommended that there be allotted the sum of $8,000.

Yellowstone Park division.

It is proposed to continue the geologic survey of the Yellowstone National Park, the work to be placed in charge of Mr. Arnold Hague, assisted by C. D. Davis, Walter H. Weed, Joseph P. Iddings, and George M. Wright.

It is recommended that there be allotted for this work the sum of $17,000.

Colorado division.

It is proposed to continue researches in the general and economic geology of Colorado, including the determination of the artesian-well water supply of the Denver basin, the work to continue under the supervision of Mr. S. F. Emmons, assisted by C. W. Cross, L. G. Eakins, G. H. Eldridge, W. F. Hillebrand, and A. M. Rogers.

For this work it is recommended that there be alotted the sum of $20,000.

California division.

It is proposed to complete during the next year the field investigations relating to the quicksilver deposits of California, and to begin work upon the general structure of the gold belt on the western slope of the Sierra Nevada, the work to continue under the charge of Mr. George F. Becker, assisted by Miss Lucas Harvey, Waldemar Lindgren, W. H. Melville, Carl Rabe, and H. W. Turner.

For the prosecution of these investigations it is recommended that there be allotted the sum of $17,000.

Volcanic division.

It is proposed to continue the study of the great volcanic district included in the Cascade Mountains, and to assign Capt. C. E. Dutton to this work, assisted by J. S. Diller, Hermann Ohm, and H. I. Van Hoesen.

For this purpose it is recommended that there be allotted the sum of $12,000.

Utah division.

It is proposed to continue the investigation relating to the silver-lead deposits of Utah and California, and especially to examine the Horn silver district of Utah during the present season, the work to be placed under the charge of Mr. J. S. Curtis; and it is recommended that there be allotted for this purpose the sum of $5,000.

Division of general geologic map.

It is proposed to continue the preparation of a general geologic map of the United States. The following persons will be engaged in this work: W J McGee and J. S. Brown.

It is recommended that for this purpose there be allotted the sum of $6,100.

Louisiana division.

It is proposed to trace upon the ground the geologic formations of Northern Louisiana, for the purpose of determining the horizon and extent of the iron ores of the region. This work will be conducted by Mr. Lawrence C. Johnson.

It is recommended that for this purpose there be allotted the sum of $1,800.

The total sum recommended for the prosecution of geologic work is $144,900.

PALEONTOLOGY.

Division of vertebrates.

It is proposed that Prof. O. C. Marsh shall continue his studies in the vertebrate paleontology of the United States, his specific line of work being the preparation of his monographs on Sauropoda and Stegosauria, to be assisted by E. H. Barbour, Thomas A. Boswick, Adam Hermann, and S. W. Williston.

It is recommended that for this work there be allotted the sum of $16,000.

Division of Paleozoic invertebrates.

It is proposed that investigations in Paleozoic-invertebrate paleontology be continued under the direction of Mr. C. D. Walcott, assisted by Cooper Curtice, John W. Gentry, James Hall, and S. H. Williams.

For this work it is recommended that there be allotted the sum of $6,000.

Division of Mesozoic invertebrates.

It is proposed that researches in the invertebrate paleontology of the Mesozoic and Tertiary formations shall be continued under the direction of Dr. C. A. White, assisted by J. P. Hendley and J. B. Marcou.

It is recommended that there be allotted for this work the sum of $7,500.

Division of Cenozoic invertebrates.

It is proposed to continue researches in invertebrate paleontology of Cenozoic and Quaternary age, the work to continue under the superintendence of Dr. W. H. Dall, assisted by Joseph B. Crowe and R. E. C. Stearns.

It is recommended that there be allotted therefor the sum of $5,000.

Division of Paleo-botany.

It is proposed to continue the researches in Paleo-botany under the general direction of Prof. Lester F. Ward, assisted by W. M. Fontaine, Dr. L. Lesquereux, Dr. J. S. Newberry, and Bruno Müller.

It is recommended that there be allotted for this purpose the sum of $7,500.

The total amount recommended for the prosecution of paleontologic investigations is $42,000.

CHEMISTRY AND PHYSICS.

It is also proposed to continue researches in chemical geology, including the study of such material as may be submitted to the chemists by the field geologists, and also to continue special lines of investigation, especially in the Appalachian Mountains, the work to continue under the charge of Prof. F. W. Clarke, assisted by D. E. Chase, T. M. Chatard, R. B. Riggs, F. A. Gooch, E. L. Howard, and J. E. Whitfield.

It is also proposed to continue work on high pressures and great temperatures. The ultimate object of this work is to make possible the solution of problems connected with the physics of the earth's crust, while the immediate purpose is to secure trustworthy methods of determining the melting points of rocks and the behavior of rock material, both solid and fused, under pressure. This work is to be under the charge of Messrs. Carl Barus and William Hallock.

For the work of this division it is recommended that there be allotted the sum of $20,000.

STATISTICS.

It is proposed to continue the collection of statistics to exhibit the mineral resources of the United States, the work to remain in the charge of Mr. Albert Williams, jr., assisted by the following persons: J. Middleton and W. A. Raborg.

It is recommended that there be allotted for this work the sum of $8,000.

LIBRARY.

Each year it is necessary to make provision for the transportation of such publications of the survey as are by law subject to exchange. It is also necessary to make additions to the library of such scientific works not to be obtained by exchange as are needed for reference by the various members of the corps.

For this purpose it is recommended that there be allotted the sum of $4,000.

ILLUSTRATIONS.

The graphic presentation, by means of illustrations, of the scientific results obtained, forms a very important feature in the publications of the survey. This work is under the immediate charge of Mr. W. H. Holmes, who is assisted by J. H. Blake, F. W. Von Dachenhausen, DeLancey W. Gill, J. K. Hillers, C. C. Jones, J. L. Ridgway, Asahel B. Searle, and Frank T. Smart, and for its continuation it is recommended that there be allotted the sum of $16,320.

FORESTRY.

It is proposed to continue investigations into the forestry of the United States, under the direction of Mr. George W. Shutt, and for this purpose it is recommended that there be allotted the sum of $4,500.

OFFICE.

For general office expenditures, including the pay of temporary assistants, such as skilled laborers, watchmen, &c., it is recommended that there be allotted the sum of $16,580.

OFFICE EMPLOYÉS.

James Barbour, jr., E. E. Barnes, J. H. Blodgett, Mark Brodhead, Samuel Brown, Mary Bryant, C. A. Burnett, C. D. Choate, A. B. Frisbie, J. W. Green, Anthony Mason, Edith V. Mullen, W. A. Niblack, Jane Peterson, John P. Ritchie, M. D. Routh, A. O. Tingley, Jane L. Ware, P. C. Warman, C. C. Wilson, and William Wines.

In the bill making appropriations for sundry civil expenses of the Government for the year ending June 30, 1886, the Geological Survey was given the sum of $467,700.

The foregoing recommendations on the part of the Director provide for the expenditure of $434,090.

It is recommended that there be temporarily reserved to defray such contingent expenses as may arise during the progress of the work in the field and office the remaining sum of $33,610.

A certain expenditure having been determined on, to be made by an assistant in charge of some work, the actual payment of money is made by a disbursing clerk or agent. The larger share of the disbursements are made by the chief disbursing clerk in Washington; but as the operations of the survey are conducted in widely separated parts of the United States, it has been found necessary to appoint other disbursing agents, and assign them to different districts. Five of these devote their time entirely, or principally, to the disbursement of money and cognate work; three others are topographers or geologists, and merely add disbursement to their other duties. All are bonded, as provided by law. When it becomes necessary to make purchases or otherwise expend money for public purposes in places to which a disbursing agent cannot economically be sent, the assistants usually advance the necessary money from their personal funds, and afterwards present to disbursing agents bills for reimbursement.

In describing the methods and general regulations under which disbursements are made, it will be convenient to consider: (1) salaries; (2) traveling expenses; (3) purchases.

Salaries.—Each salary voucher consists of three parts, a bill, a certificate, and a receipt. The bill shows the general class of the work, the period covered by the work, and the rate of pay. The certificate attests that the service was actually performed, and is signed by the person authorized to supervise the work. The receipt attests the payment of the money. The disbursing agent is not authorized to make the payment until the certificate has been signed by the proper officer.

For the payment of a single salary the following form is used:

[Salary voucher blank.]

APPROPRIATION FOR U. S. GEOLOGICAL SURVEY.

The United States, to ——— ———, *Dr.*

188–.				
		For pay as .... from .... to ...., 188–, inclusive, ... month , at $ .... per	$....	....

I certify that the above account is correct; that the services were rendered as herein stated, and were necessary for the work of the U. S. Geological Survey.

——— ———,
——— ———, *U. S. Geological Survey.*

Received at ———, this ——— day of ———, 188–, from ——— ———, ——— disbursing agent, U. S. Geological Survey, the sum of ——— dollars and ——— cents, in full payment of the above account, *having signed duplicate receipts therefor.*

(Sign here:)
——— ———.
——— ———.

(Indorsed:) Voucher No. —, ——— quarter, 188–. Appropriation for United States Geological Survey. Accounts of ——— ———, ——— disbursing agent, U. S. G. S. Paid to ——— ———, for ——— ———. Amount, $———. Paid by check No. —, for $———, dated ——— —, 188–, on ———.

When several persons are paid at the same place and time, a pay-roll is substituted. Following is the blank used:

APPROPRIATION FOR U. S. GEOLOGICAL SURVEY.

We, the subscribers, hereby acknowledge to have received of ——— ———, disbursing agent, U. S. Geological Survey, the sums herein specified opposite our respective names, being in full for our services, at ———, during the month of ———, 188–, *having signed duplicate receipts therefor:*

No.	Names.	Occupation.	Time employed.	Rate of pay.		Amount received.	Signatures.	Witnesses.
				Annual.	Monthly.			
				$0 00	$0 00	$0 00		

I certify that the above pay-roll is correct as to names, amounts, and time of service rendered.

——— ———,

——— ———, *U. S. Geological Survey.*

(Indorsed:) Voucher No. —, ——— quarter, 188–. Appropriation for U. S. Geological Survey. Accounts of ——— ———, ——— disbursing agent, U. S. G. S. Pay-roll. Amount, $———. Paid by the following checks:

Number.	Date.	Amount.	Depository.
		$.	

Traveling expenses.—The voucher for traveling expenses consists likewise of a bill, a certificate, and a receipt. The bill describes the journey, and is supplemented by a detailed statement of items of expenditure. The principal details are verified by subvouchers, or receipts, from the persons to whom the traveler makes payments; but exception is made of railway fares and other expenditures whose actuality and amount are implied by the fact of the journey. The certificate shows that the bill is approved by the person who authorized the journey, and it is supplemented by a copy of the journey order or letter of instructions in accordance with which the journey was performed. The voucher also contains, in accordance with a regulation of the Treasury Department, an attestation, under oath, by the person making the journey, that a true account of his expenses has been rendered.

[Journey order blank.]

No. ——.

U. S. GEOLOGICAL SURVEY,

....

Mr. ....

.................., 188..

....

You will proceed by the shortest practicable route from.......................... to.............................., on duty connected with this Survey, keeping a memorandum of your actual necessary expenses incurred on said journey, and attaching this order to your vouchers for said expenses, with *hotel bills, in duplicate*, appended.

——— ———,

——— ——— *U. S. Geological Survey.*

[Traveling expense voucher, first page.]

APPROPRIATION FOR U. S. GEOLOGICAL SURVEY.

The United States to ——— ———, Dr.

Date.		Designation.	Dollars.	Cts.
188–.		For actual expenses, while traveling in the discharge of duty, under orders of .... from .... to ...., and return, as per itemized statement within	....	....

I certify that the above account is correct and just; that the detailed items charged within are taken and verified from a memorandum kept by me; that the amounts charged for subsistence were actually paid, and were occasioned by official business or unavoidable delays, requiring my stay at hotels for the time specified; that I performed the journey under the order hereto annexed with all practicable dispatch by the shortest usually traveled route in the customary reasonable manner, and that I have not been furnished with transportation, or money in lieu thereof, for any part of the journey herein charged for.

——— ———,
——— ———.

Sworn and subscribed to before me at ———, this ——— day of ———, 188–.

——— ———,
Notary Public.

Received at ———, this ——— day of ———, 188–, from ——— ———, disbursing ———, U. S. Geological Survey, the sum of ——— dollars and ——— cents, in full payment of the above account, *having signed duplicate receipts therefor.*

——— ———,
——— ———.

I certify that the above account is correct and just, and is hereby approved.

——— ———,
——— ———, *U. S. Geological Survey.*

[Traveling expense voucher, second page.]

Itemized statement of actual and necessary expenses.

Date. 188–.		Number of sub-voucher.	Amounts.

(Indorsed:) Voucher No. ———, ——— quarter, 188–. Appropriation for United States Geological Survey. Accounts of ——— ———, disbursing ———, U. S. G. S. For traveling expenses. Paid to ——— ———. Amount, $———. Paid by check No. ———, for $———, dated ———, 188–, on ——— ———.

The journeys covered by such vouchers are of various kinds. Sometimes the business requires merely that an assistant shall go from one indicated point to another, following the ordinary route of travel, but more frequently the work requires that the assistant go to a district rather than a point, and travel in that district so much as may be necessary to determine certain features of its geology or topography. In such case it is impossible to describe his route in advance, since all but the initial portions of it must be determined in the light of information gathered during its progress. The authorizing letter contains only general instructions, and the details of the route appear only in connection with the details of expenditure. Sometimes the authority for a journey is contained incidentally in a letter of instructions devoted chiefly to other matters. In some emergencies the original authority is oral. In such cases a formal journey order is prepared after the completion of the journey and is attached to the voucher, the object being to exhibit to the accounting officers of the Treasury the fact that the journey was properly authorized.

I will here show you the account of Mr. F. M. Pearson, who has charge of one of the small parties in the Appalachian Mountains. This is an itemized statement of the expenses of a journey, with the vouchers attached thereto, and the certificates and affidavits necessary to substantiate the account. It has very many items, and, you see, each item is covered by a voucher or a receipt from every man to whom any sum of money was paid.

[The account was exhibited.]

By the CHAIRMAN:

Q. At some stage in your examination I would like to question you about this.

A. I am ready to answer now.

Q. I see that this is a detailed statement of all expenses of this person.

A. Yes, sir.

Q. With the subvouchers which he took from the people who furnished any services?

A. Yes.

Q. Now, in taking these accounts to the Treasury, are these vouchers examined in their items by the accounting officers?

A. Yes, sir, twice; once in the Auditor's office and once in the Comptroller's.

Q. In detail?

A. In detail. This very week I have approved an account of this kind for two hundred and eighty-eight dollars and some cents, and there were more than one hundred and fifty vouchers in duplicate to cover the amount.

Q. So that the expenditures are in very small amounts, many of them?

A. Yes, sir.

Purchases.—In the conduct of a considerable portion of the work it is not possible, and in the case of another it is not economic, to subsist and lodge the traveling geologist or topographer at hotels. Rations are therefore furnished, equipage is provided, and camp hands are employed. The receipts for these expenditures are sometimes accounted separately, but they are usually attached as subvouchers to traveling expense vouchers. The amount of work performed in this way is so large that it has been found necessary to regulate it somewhat in detail. A ration has been established, and articles of food not included, or quantities greater than those indicated, are not paid for with public funds. The following list shows the articles of the ration and the quantities contained in one hundred rations.

The Survey ration.

Article.	Unit.	100 rations.
Fresh meat (beef, veal, mutton, lamb, pork, fish, venison)	Pounds	100
Cured meat (bacon, pork, ham, corned beef, cured fish)	... do	50
Lard	....do	5
Flour, or equivalent in bread	....do	80
Corn-meal, hominy, oat-meal, or cracked wheat	....do	15
Yeast powder	Cans, half-pound	10
Sugar	Pounds	40
Coffee, green	....do	12
Tea	....do	1
Milk, condensed	Cans	4
Dried fruit (apples, peaches, plums, &c., or equivalent of fresh fruit, not canned).	Pounds	20
Rice or beans	....do	20
Potatoes, or equivalent in other vegetables	....do	75
Spices	Ounces	2
Ginger	Pounds	1
Mustard	....do	1
Flavoring extracts	Bottles	2
Pepper	Pounds	¼
Pickles	Quarts	3
Vinegar, or equivalent in lime juice	....do	1
Salt	Pounds	4

By the CHAIRMAN:

Q. Who establishes the ration?

A. The Secretary of the Interior.

The voucher which represents a purchase consists of a bill, a receipt, and two certificates. The bill specifies each article purchased, with its quantity, and the price per unit. One certificate attests that the purchase is for the purposes of the Survey, and has been completed by the delivery of the goods. The second declares that a certain assistant becomes responsible for the property acquired. The assistants who assume this responsibility are called custodians, and their functions will be described in connection with the account, presently to be given, of the custodial system.

The accompanying is a copy of the purchase voucher blank:

APPROPRIATION FOR U. S. GEOLOGICAL SURVEY.

The United States to —— ——, Dr.

Date.			Cost.	
			Dollars.	Cts.
188-.				

Received at ——, this —— day of ——, 188-, from ——, —— disbursing ——, U. S. G. S., the sum of —— dollars and —— cents, in full payment of the above account, *having signed duplicate receipts therefor.*

[Sign here:] —— ——.

I certify that the above account is correct; that the articles herein enumerated have been received or services performed; that they were necessary for, and have been, or will be, applied to the work of the U. S. Geological Survey, and that, to the best of my knowledge and belief, the prices paid were reasonable and just.

—— ——,
—— —— *U. S. Geological Survey.*

(On the margin:) I certify that the articles herein named will be accounted for on my returns for the —— quarter, 188-. —— ——, custodian.

(Indorsed:) Voucher No. —, ——. Quarter, 188-. Appropriation for United States Geological Survey. Accounts of —— ——, —— disbursing ——, U. S. G. S. Paid to —— ——, for —— ——. Amount, $——. Paid by check No. —— for $——. Dated —— —, 188-, on —— ——.

The greater share of the purchases of the Survey are made in or from the city of Washington. Stationery, coal, and other office supplies, so far as possible, are purchased through the Department of the Interior, under standing contracts made by that Department. For most other articles the principle of competition is employed in securing reasonable prices. If a case of drawers or a number of such cases are to be made, the specifications are submitted to a number of cabinetmakers in Washington and Baltimore, and the bids received determine the letting of the contract. A similar course is followed with reference to numerous standard articles which are ordinarily kept in stock by merchants. For standard drawing instruments and standard photographic apparatus, contracts are made with dealers to furnish the quantities desired from time to time, at rates computed from the trade catalogues by deducting a certain stipulated percentage.

In the interest of economy the competitive system is not applied to small purchases of articles needed for immediate use. These are bought in the open market, at current retail rates. So, too, small purchases which have to be made by traveling assistants at a distance from Washington are not subjected to the rules of the central office. The assistants having, as previously explained, a personal and professional interest in the practice of economy, are allowed to use their own discretion in the selection of methods for the securement of reasonable prices. For large orders they ask bids from competing sellers; and a very large share of their supplies they obtain through the central office, thus availing themselves of the advantageous standing contracts made by the Interior Department and the Geological Survey.

The disbursing agents report weekly to the Director their total disbursements, their balances of funds in personal possession, and their balances in United States depositories. The last are communicated to the Treasury Department and there compared with the reports of the depositories. The result of the comparison is regularly reported to the Director of the Survey.

[Blank for weekly statement of disbursing agent.]

DEPARTMENT OF THE INTERIOR,
U. S. GEOLOGICAL SURVEY,
——— ———, 188–.

SIR: I have the honor to report my balance of public funds on deposit and in hand at the close of the week ending ———, as follows:

Balance as shown by report for week ending.............. $............
Received since last weekly report ....$..........

Expended during the week ....
Transferred and deposited to credit of United States Treasurer ....

Total amount for which I am accountable.......................... ....

which is accounted for as follows:

DEPOSITED WITH—

______________________________ $..........
______________________________ ....
______________________________ ....
______________________________ ....
In checks or drafts ....
In personal possession ....

WITH OTHER PARTIES, VIZ:

________________________________ $...........

________________________________ ....

IN TRANSITU:

From .... $...........

To ....

________________________________ ....

Total as above ....

Very respectfully,

____ ____,

____ ____.

To the DIRECTOR OF THE U. S. GEOLOGICAL SURVEY,
Washington, D. C.

(Indorsed:) U. S. Geological Survey. Weekly statement of public funds for the week ending ———, 188-. ——— ———, ——— ———. $———.

NOTE 1.—This statement will be made and forwarded promptly, at the close of each week, to the Director of the Geological Survey.

NOTE 2.—Disbursing officers are required by act of March 3, 1857, to deposit *all* money intrusted to them for disbursement with some designated depository of the United States, and to make payments by checks. This requirement should be strictly observed, officers keeping money in hand at their own risk only when the necessities of the service make it indispensable, and when the special authority of the Secretary of the Interior has been obtained therefor.

NOTE 3.—When money is deposited to credit of the Treasurer of the United States the "*original*" certificate of deposit should be transmitted at once to the Secretary of the Treasury; the fact and date of transmittal should be indorsed on the other, which should be retained by the officer, and the Director of the Geological Survey should be at once informed of the deposit by letter. In taking credit in account current for deposits made, officers should state specifically the date of the deposit, the designation and location of the depository in which the deposit was made, as well as the appropriation to which the deposit belongs, and the fiscal year for which the money was appropriated.

NOTE 4.—Money received from sales of public property will be promptly deposited with the nearest assistant treasurer or other Government depositary designated by the Secretary of the Treasury, to credit of Treasurer of the United States as miscellaneous receipts on account of "proceeds of Government property," and cannot be withdrawn or applied except in consequence of a subsequent appropriation made by law. (See Revised Statutes, Title XL, sec. 3618.)

NOTE 5.—Applications for remittances from the Treasury should not exceed such amount as may be estimated to be needed, in addition to the GENERAL BALANCE in hand, to defray the total estimated expenditures in the month for which the remittance is asked.

Blank for abstract of weekly statements of funds in depositories.

Depository.	John D. McChesney, chief disbursing clerk.		Depository.	P. H. Christie, special disbursing agent.	
	Week ending *October* 31, 1885.			Week ending *October* 31, 1885.	
	Report by officer.	Report by depository.		Report by officer.	Report by depository.
Treasurer of the United States, Washington, D. C.	$10,089 80	$11,909 90	*Treasurer of the United States, Washington, D. C.*	$11,925 56	$17,645 85
Assistant treasurer of the United States, New York, N. Y.	6,901 05	9,430 16			

Depository.	Henry C. Rizer, disbursing agent.		Depository.	Anton Karl, special disbursing agent.	
	Week ending *October* 31, 1885.			Week ending *October* 31, 1885.	
	Report by officer.	Report by depository.		Report by officer.	Report by depository.
Assistant treasurer of the United States, New York, N. Y.	$1,170 19	$4,469 82	*Assistant treasurer of the United States, New York City*	$81 95	$229 45
Assistant treasurer of the United States, San Francisco, Cal	1 66	1,102 12			

[Indorsement.]

U. S. GEOLOGICAL SURVEY.

Abstract of weekly statements of funds.

U. S. GEOLOGICAL SURVEY,
Washington, D. C., November 19, 1885.

Respectfully referred to the Treasurer of the United States for a statement of the amounts deposited to the credit of the within-named officers on the dates herein specified, as reported from the depositories.

J. W. POWELL,
Director.

UNITED STATES TREASURY,
Washington, D. C., November 20, 1885.

Respectfully returned to the Director of the Geological Survey.
The information desired will be found noted in the proper column.

W. H. GIBSON,
For Treasurer of the United States.

The disbursing agents render also quarterly accounts, called "accounts current," to the Treasury. Each such account current is accompanied by a ledger account called an "abstract," on which are assembled, in order, the payments more fully detailed in the accompanying vouchers. The vouchers, giving the original transactions in full, serve the purpose of a day-book, with receipts.

[Appropriation for United States Geological Survey, fiscal year ending June 30, 188–.]

The United States in current account with ——— ———, disbursing ———.

DR. CR.

188–.			188–.		
	To amount expended during the ——— quarter of 188–, as per vouchers and abstracts herewith. To balance due the United States carried to new account.			Due the United States as per account current rendered for the quarter of 188–. By Treasury draft No. ——, on Interior civil warrant No. ——.	

I certify that the foregoing is a true account of all money received by me from the appropriation for United States Geological Survey, not heretofore accounted for; and that the disbursements have been faithfully made.

——— ———,
——— *Disbursing* ———, *U. S. G. S.*

Dated at ——— ———,
——— —, 188–.

(Indorsed:) Appropriation for United States Geological Survey. Account current of ——— ———, ——— disbursing ———. For the ——— quarter of 188–. Fiscal year ending June 30, 188–.

[Abstract of disbursements blank.]

Appropriation for U. S. Geological Survey. Abstract of disbursements made by ——— ———, disbursing ———, U. S. Geological Survey, during the ——— quarter of 188–.

Number of voucher.	To whom paid.	For what paid.	Amount.	
			Dollars.	Cents.

(Indorsed:) Appropriation for United States Geological Survey. Abstract of disbursements by ——— ———, ——— disbursing ———, U. S. G. S., during the ——— quarter of 188–. $———.

An important principle observed in this system of accounts is that the documentary authority and responsibility should coincide with the actual authority and responsibility. Wherever administrative authority is delegated to subordinates, and much authority is thus delegated, alike from necessity and from policy, the practice of the bureau does not permit it to remain nominally, by conventional fiction, with the chief. No person is called on to certify to the correctness of a voucher unless the expenditure is under his immediate supervision or he has other means of knowing the facts in regard to it. It is believed that the contrary principle, by introducing official indirection, tends to the degradation of business habits.

There is another important principle observed in the preparation of a voucher: It is required that the transaction which it covers shall be completely stated; and if an article is purchased or other expenditure is made of an extraordinary character, not usually authorized, but necessary because of some peculiar circumstance, a full explanation of such circumstance must be given. Thus, in the employment of an Indian guide, a money payment may not be practicable. It may be necessary to furnish him tobacco, or a blanket, and a voucher for tobacco purchased for that purpose must be explained, by stating upon the face of it that the tobacco is to be used in the payment of an Indian. It has just happened that an employé coming from Philadelphia to Washington by the night train charged for his breakfast, when under ordinary circumstances he should have arrived in Washington and taken his breakfast at home, but on the face of the voucher the explanation appears that the train was delayed by accident upon the road, and the assistant was compelled to take his breakfast in Baltimore. The Director himself might be able in all of these cases to determine the propriety of such an expenditure without having it explained upon the voucher, but it is the theory of the Survey that all such knowledge in the possession of the Director shall be conveyed to the accounting officer of the Treasury.

For the purpose of convenient access each disbursing agent is required to assemble certain of the data embodied in his vouchers in a monthly report. This report enumerates the persons employed, buildings rented, and articles hired in connection with the work for which he disburses, and it is so arranged as to exhibit a variety of desirable additional information.

[**Blank for report of persons and articles hired.**]

Report of persons and articles employed and hired at ———, during the month of ———, 188—, by ——— ———, ———, U. S. Geological Survey.

Number.	Names of persons and articles.	Designation and occupation.	Services during the month.			Rate of hire or compensation.			Date of contract, agreement, or entry into service.	By whom owned.	Amount of rent or pay in the month.		REMARKS.—(Showing how the persons were employed during the month. By whom the buildings were occupied, and for what purpose. Discharges will be noted under this head, date, &c.)	Time, and the amount due and remaining unpaid.			
			From—	To—	Days.	Dollars.	Cents.	Day, month, or annual.			Dollars.	Cents.		From—	To—	Dollars.	Cents.
	Amount of hire and rent during the month...............							......	......	....			Total amount due and remaining unpaid..........				

I certify that the above is a true report of all persons and articles employed and hired by me during the month of ———, 188—, and that the statements of amounts due and remaining unpaid are correct.

——— ———,
——— ———, *U. S. G. S.*

(Indorsed:) United States Geological Survey. Report of persons and articles hired for the month of ———, 188-. By ——— ———, ——— U. S. G. S. At ———. One copy to be forwarded to the Director of the U. S. Geological Survey at the end of each month.

The relations of the Government to those railroads which have received subsidy or grant of land are somewhat complicated, and the transaction of business with them is subject to special laws and special departmental regulations. In accordance with these regulations the business of the Geological Survey is conducted in the following manner: When an employé is required to travel on a "bonded" railroad, he is provided with a specific request for transportation, signed by the Secretary of the Interior, and countersigned by the Director of the Geological Survey. This he presents in lieu of payment of fare, and on receiving the transportation he signs an acknowledgment of the same. The railroad company attaches the request and acknowledgment to a bill which it sends to the central office of the Survey, and this bill, after verification, is forwarded for settlement to the Treasury. In the books of the Treasury the Geological Survey is charged the amount of the bill, and the railroad company is credited.

Upon railroads other than "bonded" a similar request is sometimes used to relieve the assistant of the necessity of advancing money, and the bill rendered by the company is then settled from the central office of the Survey.

[Blank transportation request and coupon.]

[Not valid unless countersigned. Not transferable. Good only for .... from date.]

Government request for transportation.

UNITED STATES, DEPARTMENT OF THE INTERIOR,
Washington, D. C., ..., 188..

The .... Rail ...... Company will please transport .... and ...... other person , with ...... pounds of extra baggage, from .... to .... en route from .... to .... ; for which said company will be reimbursed in accordance with existing law, from the ..... appropriation for ....

—— ——,
Secretary.

Countersigned:
—— ——,
——.

NOTE.—The officer countersigning will fill out complete; and the holder of the request, upon presenting it for transportation, will date, fill out in full, and sign in ink the certificate below.

...................., 188..

I certify, on honor, that the .... Rail ...... Company has furnished transportation for myself and ...... other person , and ...... pounds of extra baggage, from .... to ...., in compliance with the above request.

—— ——,
——.

No. ... $ ....

[Coupon attached.]

[The holder will send this coupon by first mail to Secretary of Interior.]

Government request, account of .... office, No. ...., dated .... 188., in favor of .... and ...... other person , with ...... pounds of extra baggage, from .... to .... , has this ...... day of ...., 188 , been signed by me and delivered to the agent of .... Rail .... Company at ....

—— ——,
——.

No. .....

The regulations of the Interior Department require the director to countersign the transportation request, but it becomes necessary in the conduct of the business of the Survey, as already explained, to delegate to assistants the actual determination of the routes of journeys. The transportation request is therefore signed in blank not only by the Secretary but also by the director, and to guard against its misuse special precautions are necessary. The requests are numbered in a continuous series, record is kept of all issues, and persons to whom they are intrusted are required to account specifically for each request.

With reference to the shipment of Government property there are special regulations applying not only to bonded railroads but also to land-grant railroads, and all accounts affecting such roads are settled through the Treasury Department substantially in the same manner. On account of certain difficulties which arise in the transfer of shipments from one railroad to another, the Survey has found it advantageous to avail itself of the forwarding system established by the Quartermaster-General of the Army. Under authority contained in an order by the Adjutant-General of the Army, issued February 7, 1880, assistants of the Geological Survey having freight to forward are permitted to put it in charge of quartermasters and quartermasters' agents, and this method of shipment is often employed. Nevertheless, the restrictions upon the transaction of business which arise from the indebtedness of railroads to the Government are so great, and occasion such expense and delay, that, where distances are not long and shipments are not large, it is found economic to forward by express.

Monthly reports.—It has been seen that the assistants of the Geological Survey are organized into parties, a field of work is given to each party, and a sum of money allotted for the expense of the work. As the work progresses a monthly report of operations is made by each chief of party, and a summary of these reports is prepared by the Director and submitted to the Secretary of the Interior, in order that he may be informed of the progress of the work, according to the plan submitted to him at the beginning of the fiscal year.

In the central office an allotment book is kept by the chief disbursing clerk, and a statement begun therein against each chief of party to whom an allotment has been made, by entering the amount of the allotment and designating the permanent employés to be paid therefrom, together with the amount to be paid each one. As expenditures are made, in the field or by the chief disbursing clerk, the amounts are at the time entered in this book, so that the condition of the allotted fund may be known at any time.

There is still another account of all disbursements: a book entitled Classification of Expenditures is kept. In a book of regulations, which has been prepared for the instruction of disbursing officers and custodians, the materials used by the Geological Survey are classified in schedules, for purposes therein set forth. The following is the system of classification thus used:

List of schedules.

Schedule A. Services.
B. Traveling expenses.
C. Transportation of property.
D. Field subsistence.
E. Field supplies and expenses.
F. Field material.
G. Instruments.
H. Laboratory material.
I. Photographic material.
K. Books and maps.
L. Stationery and drawing material.
M. Illustrations for reports.
N. Office rents.
O. Office furniture.
P. Office supplies and repairs.
Q. Storage.
R. Correspondence.

This system of classification is kept up, and when vouchers are sent in, the nature and amount of every expenditure is transferred to this book under its proper class. A summation of the entries thus made is a complete classification of the expenditures of each party; a consolidation of these expenditures constitutes a complete classification of the expenditures of the Survey, and is published in the annual report.

Auditing of accounts in the survey office.—Finally, it should be stated that all accounts are carefully audited by the Director, assisted by the chief disbursing clerk and the chief clerk, before they are sent to the Treasury for final settlement. This auditing can be done much more thoroughly in the office of the Survey than in the Treasury Department, from the fact that all of the transactions represented by the accounts—their necessity and purpose—are there thoroughly understood, and it is the purpose of the Director to have the accounts so thoroughly scrutinized that no objection can be raised to them in the Treasury.

By Mr. HERBERT:

Q. Has your report for the last year been published?

A. It is composed; not yet printed.

Q. It is in the hands of the printer?

A. Yes, sir; it is in the hands of the printer, and is set up in type, or composed, as it is technically called, but is not yet printed.

By Mr. MORGAN:

Q. Your accounts, besides being audited by yourself, are audited by the accounting officers of the Treasury?

A. First by the First Auditor, and second by the First Comptroller; they go through two offices in the Treasury, where they are critically examined.

Q. This auditing done by yourself is not the auditing required by the Government?

A. No, sir; the official auditing is in the Treasury, but as I know of the circumstances surrounding the transaction, and the purposes for which an expenditure is made, I can examine the account more critically and thoroughly than an officer in the Treasury Department.

By the CHAIRMAN:

Q. How do you audit these accounts; you simply have them carefully scrutinized, I suppose, by trusted people in your office, and then put your signature to them?

A. I have them examined by trusted persons in my office, and from time to time, as the vouchers are sent to the office, they are brought by the chief disbursing officer to myself for examination, and if approved by me my signature is attached.

By Mr. MORGAN:

Q. Have you described on this statement the method by which you obtain money from the Treasury?

A. No, sir.

Q. Please state how you get money from the Treasury.

A. The disbursing officer is bonded. If it is desired to put a certain amount of money subject to the check of such disbursing officer, a requisition is made out in the Geological Survey, signed by myself, and sent to the Secretary of the Interior, and if approved by him is forwarded to the Treasury.

Q. Do these requisitions state the precise purposes for which the money is intended?

A. No, sir.

Q. You do not draw generally a lump sum; don't you specify what it is to be applied to?

A. No, sir; we do not specify the articles.

Q. But the field in which it is to be expended?

A. Yes, sir; that is involved in the requisition; the disbursing officer disburses for some district of country or set of men.

Q. You specify whether it is geological, paleontological, or any other ologies?

A. No, sir.

By the CHAIRMAN:

Q. Does the same disbursing officer, for example in a distant region, disburse for the geographers, the paleontologists, and the geologists?

A. Yes, sir.

Q. The same disbursing officer pays all of them?

A. Yes, sir.

By Mr. MORGAN:

Q. How much bond is he required to give?

A. It varies somewhat; the chief disbursing officer gives bond in the sum of $40,000; others vary from $5,000 to $20,000, according to the amount to be disbursed by them.

Q. Does the Secretary of the Interior take any control at all of the work in the field?

A. I submit my plan to him. Since I have been in the service my plan has never been disapproved.

Q. He approves the plan?

A. He approves the plan, and sends me an order to proceed in accordance with it.

Q. You name the individuals and the field of work?

A. Yes, sir.

Q. His approval of your plans amounts to an order to go on and work as indicated?

A. Yes, sir.

CUSTODIAL SYSTEM.

Every article purchased with the funds of the Survey is put in the official custody of an assistant, who is held responsible for it. The assistants assuming this responsibility are entitled "custodians," and their number is made large, so that the care and responsibility may be actual and not merely nominal and documentary. Fourteen assistants are now custodians, of whom ten are geologists or topographers, and four are disbursing agents or clerks.

Account of property is rendered quarterly, in a report known as the "quarterly return of property." This exhibits for each class of property the amount in charge of the custodian at the beginning of the quarter, the amount received during the quarter, the amount parted with during the quarter, and the amount for which he remains responsible. Every article, the acquisition of which is shown by a purchase voucher, is entered upon the return of some custodian, and this entry is perpetuated from quarter to quarter until the article passes from his custody.

[Form of quarterly return of property.]

Return of U. S. Geological Survey property, —— *quarter of* 188–.

LIST OF ARTICLES. NOTE.—As many lines to be allowed for each article as will give sufficient space in the column of "REMARKS."	Designation, as Lbs., Galls., No., &c.	On hand as per last return.	Received during the quarter.	Total to be accounted for.	Disposed of during the quarter.	On hand —— day of ——, 188–.	REMARKS. NOTE.—In this column will be stated, opposite the name of each article, whether what was "*received during the quarter*" was by purchase or otherwise, and whether paid for or not. Also, whether what was "*disposed of*" was expended or transferred, or otherwise disposed of. If expended, the object of expenditure to be stated; if transferred, the person to whom, and the authority; if disposed of otherwise than by expenditure or transfer, the authority and manner to be stated.

I certify that the foregoing return is a true statement of the public property in my charge for the quarter ending ——— day of ———, 188–.

——— ———,

——— *U. S. Geological Survey.*

(Indorsed:) U. S. Geological Survey. Property return for the quarter ending ———. 188–. Rendered by ——— ———, U. S. G. S.

When property is transferred from one district to another the accountability is frequently transferred from one custodian to another. This is done by means of an invoice and a receipt.

[Invoice of property blank.]

UNITED STATES GEOLOGICAL SURVEY.

Invoice of ———, *transferred by* ——— ———, *of the U. S. Geological Survey, at* ———, *to* ——— ———, *at* ———, *on the* ——— *day of* ———, 188–.

Number.	Quantity.	Articles.

I certify that I have this day transferred to ——— ——— the above specified articles.

——— ———,
U. S. Geological Survey.

[Sign in duplicate.]

(Indorsed:) United States Geological Survey Invoice of property transferred to ——— ——— by ——— ———, U. S. Geological Survey. ——— quarter, 188–.

[Receipt for property blank.]

UNITED STATES GEOLOGICAL SURVEY.

Received at ———, *this* ——— *day of* ———, 188–, *from* ——— ———, *the following-named articles:*

Number.	Quantity.	Articles.

——— ———,
——— ——— *U. S. Geological Survey.*

[Sign in duplicate.]

(Indorsed:) United States Geological Survey. Receipt for property invoiced to ——— ——— by ——— ———, U. S. G. S. ——— quarter, 188–.

The word "expendible" is a technical term applied to property which is either immediately consumed in use (for example, flour), or is quickly worn out (for example, brooms), or is perishable (for example, test-tubes). When expendible property has been consumed or destroyed, the custodian to whom it was chargeable is released from accountability, and is permitted to record it as "expended" and drop it from his returns. In the printed "Regulations of the United States Geological Survey" expendible property is carefully discriminated from non-expendible by means of extended lists. If non-expendible property is worn out or otherwise rendered unserviceable, the custodian reports the fact to the Director, and requests to be relieved of responsibility. This relief the Director authorizes in writing, after having satisfied himself of its propriety by means of an inspection by disinterested persons, or by such other means as he judges expedient.

In the conduct of field operations it sometimes occurs that property is lost or destroyed under circumstances not involving blame on the part either of the custodian or of the person using the property. In such cases the custodian is relieved of accountability, but it is required that affidavit be made to the circumstances.

[Affidavit blank.]

UNITED STATES GEOLOGICAL SURVEY.

———, ———,
———, 188–.

Personally appeared before me, the undersigned, a ———, who deposes and says that on the ——— day of ———, 188–, ——— ——— ———, the property of the United States Geological Survey, ———, under the following circumstances:

And he further deposes and says that said ——— was not the result of carelessness, negligence, or disobedience of orders, and that no blame can be attached either to ——— ———, who is responsible for said property, or to any person in whose charge the above ——— ——— at the time said ——— occurred.

——— ———.

Sworn and subscribed to on this ——— day ———, 188–. In testimony whereof I have hereunto set my hand.

——— ———,
——— ———.

(Indorsement:) United States Geological Survey. Affidavit as to loss of property, made by ——— ———, ———, United States Geological Survey.

It sometimes occurs that property becomes unserviceable for the purposes of the Survey, and yet has some small value. If such property is in Washington it is turned over to the Interior Department, and is no longer held in the custody of the Survey. The officers of the Department have it sold and the proceeds turned over to the Treasury Department. But if such property is in the field, the custodian having charge of it reports the facts to the Director, and is authorized by him to sell the same at public auction. The following poster is used to advertise the sale through the district of country in which such sale is to be made. The money accruing from the sale is covered into the Treasury, and the custodian is relieved from further responsibility by being authorized to drop the articles from his return:

AUCTION SALE.

Government sale of unserviceable property belonging to the U. S. Geological Survey.

On ——— morning, ——— ———, commencing at ——— o'clock, at ——— ———, will be sold the following property:

Terms: Cash in U. S. currency on day of sale, and all purchases to be removed immediately after the sale.

J. W. POWELL,
Director U. S. Geological Survey.

——— ———.

Instructions to Survey officers.

Before property is offered for sale it must be regularly condemned as unserviceable after proper inspection, as provided by the regulations of the Survey, on Form 9–047, and authority for the sale must be secured from the Director of the Survey. A detailed statement should be rendered of the articles sold and the price secured for each.

The proceeds of sales of public property must be paid into the Treasury as miscellaneous receipts, without any abatement or reduction whatever. Sales should be made at auction by persons already in the employ of the Survey who may be competent to perform such service. The proceeds must be transmitted to the Director of the Geological Survey, who will place the same to the credit of the Treasurer of the United States.

It will appear from the preceding that a custodian incurs responsibility, first, through purchase vouchers, and, second, through receipts for property transferred to him. He is relieved of responsibility, first, by invoice of property transferred to other custodians; second, by "expenditure;" third, by written authority of the Director in the case of property sold or abandoned as unserviceable; and fourth, upon affidavit to the accidental loss of property. Complete documentary evidence is thus preserved of the custody and disposal of every article purchased.

The property returns of the various custodians are compiled quarterly at the central office in a single "consolidated return," which exhibits in a summation the nature and amount of the property of the Survey and the several persons in whose custody it remains.

[Form of consolidated return.]

U. S. GEOLOGICAL SURVEY.

Consolidation of public property.

——— quarter, 188—.

Quantity.	On hand.	Received.	Total.	Expended.	On hand.	Quantity.	On hand.	Received.	Total.	Expended.	On hand.

It should be stated further in this connection that the custodial system for field instruments differs somewhat from that adopted for other property. Field instruments very frequently change hands, and sometimes must be sent from one district to another on brief notice, as circumstances demand; but the principles involved are the same, and thorough responsibility is secured.

Documents and library.—The distribution by the U. S. Geological Survey of its publications is regulated by law; it is provided in a statute approved March 3, 1879, that "three thousand copies of each shall be published for scientific exchanges and for sale at the price of publication; and all literary and cartographic materials received in exchange shall be the property of the United States and form a part of the library of the organization. And the money resulting from the sale of such publications shall be covered into the Treasury of the United States." By the provisions of this clause the distribution of publications and the acquisition of works for the library are so associated that it has been found convenient to unite them in administration. The exchanges are conducted by the librarian and the sales are made by the librarian in conjunction with the chief disbursing clerk.

The institution of the exchange was recognized as an important trust, for if wisely administered it would not only build up a geologic library of great value and utility, but would give to the publications of the survey a highly advantageous circulation. After formulating the general principles which should determine the selection of the individuals and institutions to constitute the exchange list, the Director called on his principal assistants for such specific information in regard to the standing of individual geologists and the character of American and foreign institutions as their special studies and their correspondence enabled them to give. He appealed also to a number of foreign correspondents for advice in regard to the institutions of their several countries.

The spirit of the statutory clause required that no exchange be established which would not bring into the library matter germane to the work of the Survey. Subject to this limitation the list was made to include all American scientific societies, all American scientific journals, and all State surveys. Of foreign societies and institutions it was made to include, first, those whose publications are wholly or chiefly geologic; second, those whose publications on cognate sciences or on science in general are of the first rank; third, those established in remote and little known regions of the world. In the selection of individual geologists the prime consideration was the scientific value of published works. The completed list was submitted to the Secretary of the Interior, and by him approved. Correspondence was then instituted with the various persons and institutions, and with small exception the desired arrangements were made.

Correspondents are divided into two classes. To those of class A are sent all the publications of the Geological Survey as they appear; to those of class B only the annual reports are sent. All correspondents furnish to the Survey their current publications. All individual correspondents have furnished, as far as possible, their back publications, and so have many of the societies, journals, and institutions.

From time to time slight changes have been made in the list. Some correspondents have died and others have been added. As it stands at present it includes 153 American and 208 foreign geologists. It includes 187 American and 887 foreign institutions. It should be remembered that 1,900 copies, the "usual number," are distributed through Congress to individuals and libraries throughout the United States, and that this distribution does not come under the control of the Director. The whole number of correspondents is 1,435, and their classification is fully exhibited in the following table:

Summary of exchange list.

	Class A.			Class B.			Both classes.		
	Institutions.	Persons.	Total.	Institutions.	Persons.	Total.	Institutions.	Persons.	Total.
American	165	55	220	22	98	120	187	153	340
Foreign	441	24	465	446	184	630	887	208	1,095
Total	606	79	685	468	282	750	1,074	361	1,435

This system of exchange applies only to correspondents who publish valuable matter germane to the technical library of the survey. With other persons desiring publications of the survey exchanges are arranged on the basis of cash valuation. With several dealers in scientific books exchanges are made at current trade rates, a ledger account being kept in the usual manner.

When books are delivered by the Public Printer receipts are signed by the librarian, and a record is also made when books are sent out. These records are multiple, and are so arranged as to give at once the following information: First, the number of copies of each publication which have been distributed; second, the addresses to which they have been sent; third, the number remaining on hand; fourth, the particular publications which have been sent to each address, and the dates of sending; and fifth, with reference to each address, the publications which have been acknowledged. Publications sent abroad are forwarded through the Smithsonian Institution. Those distributed in the United States are forwarded partly in the ordinary mail and partly under registration.

In addition to the documents placed in the hands of the Survey for sale and exchange, a certain number have from time to time been assigned to it by Congressional joint resolution for gratuitous distribution. The survey has thus received 2,000 copies of its first Annual Report, 2,500 copies of the second, 2,500 copies of the third, and 5,000 of the fourth. There have also been ordered for its use by the Secretary of the Interior 2,000 copies each of Mineral Resources of the United States for 1882 and for 1883 and 1884; 250 of A New Method of Barometric Hypsometry; 250 of Abstract of a report on Geology and Mining Industry of Leadville; 500 of Bulletin No. 5; 200 of Bulletin No. 25, and 100 of Bulletin No. 26. It has likewise received for distribution about 500 copies of the last (twelfth) Annual Report of the United States Geological and Geographical Survey of the Territories, in charge of Dr. Hayden, and 375 copies each of Volumes III and VIII of the Final Reports of that Survey. In the distribution of these the same system of records has been employed.

In the execution of the provision for the sale of publications, the correspondence has been conducted by the librarian, and the money received by the chief disbursing clerk. At the expiration of each quarter it is covered into the Treasury. The ledger account kept with each publication is so arranged as to show the disposition of each copy, whether by scientific exchange, commercial exchange, gratuitous distribution, or sale, and it enumerates the recipients. Taken in connection with the stock on hand, it affords a check on the account rendered of cash receipts.

A selection from the blanks employed by the librarian is here appended, in further illustration of his system of exchange and sales.

[Blank letter announcing the sending of an exchange document by domestic mail.]

DEPARTMENT OF THE INTERIOR,
U. S. GEOLOGICAL SURVEY,
Washington, ——— ——, 188–.

To ——— ———,
——— ———:

SIR: I send you by registered mail to-day a copy of the Paleontology of the Eureka District, by Charles D. Walcott.

Please fill out the inclosed receipt and return it to the Director of the U. S. Geological Survey, Washington, D. C.

By order of the Director.

Yours, respectfully,

JAMES C. PILLING,
Chief Clerk.

[Blank letter announcing the sending of an exchange document to a foreign address.]

DEPARTMENT OF THE INTERIOR,
U. S. GEOLOGICAL SURVEY,
Washington, —— ——, 188–.

To —— ——,
—— ——:

SIR: I have the honor to send to your address, *Paleontology of the Eureka District, by Charles D. Walcott.*

As this volume cannot be transmitted by mail, it is sent through the Smithsonian Institution's international exchange. It may not reach you, therefore, for some time after the reception of this letter.

Please fill out the inclosed receipt and return it post paid, to the Director of the U. S. Geological Survey, Washington, D. C.

By order of the Director.

Yours, respectfully,

JAMES C. PILLING,
Chief Clerk.

[Blank receipt for the same.*]

Date, —— ——, 188–.

To the Director U. S. Geological Survey, Washington, D. C.:

SIR: I have to acknowledge the receipt of one copy of the *Paleontology of the Eureka District, by Charles D. Walcott.*

Very respectfully,
Name, —— ——.
Permanent address, —— ——.
City or town, —— ——.
Country or State, —— ——.

Blank card for recording documents sent to a correspondent, and acknowledgment of the receipt of same.

Doe (John),
Boston,
Mass.

A I ...., 188	1 ...., 188	7 ...., 188	13 ...., 188	19 ...., 188	25 ...., 188
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* A neglect to return this receipt carefully filled in below will be regarded as an indication that none of the future publications of the Survey are desired by you.

The library is not of a general nature, but is highly specialized in order that it may serve as a tool in the performance of the peculiar functions of the survey. It contains primarily treatises and papers on geology, including, besides general geology, paleontology, lithology, and economic geology, and in this department it is desirable to make it as complete as possible. So many geologic papers are contained in scientific journals and in the memoirs of scientific societies that full sets of many such serial publications must be obtained. In the cognate sciences of chemistry and biology, whose data are accessory to the pursuit of paleontology and lithology, a considerable body of selected literature is secured and more is desired.

The collection of books now constituting the library contains, first, a small nucleus inherited from the Hayden and Powell surveys; second, a portion of the library of Mr. Robert Clarke, of Cincinnati, which was exceedingly rich in the official geologic literature of the United States, and which was purchased for the sake of meeting immediately and economically an urgent need; third, an equal number of volumes purchased individually or in small lots; fourth, gratuitous contributions from various sources; and fifth, the material acquired by exchange. As will appear by the accompanying tabular statement, only a fourth part of the whole has accrued by purchase.

	Books.	Pamphlets.	Total.
From Hayden and Powell surveys	400	....	400
By purchase:			
Clarke Library	1,894	....	1,894
Miscellaneous	1,896	1,200	3,096
By exchange and donation	11,406	12,000	23,406
Total, December 7, 1885	15,596	13,200	28,796

The current growth of the library is chiefly by exchange, but a small fund is devoted to the purchase of books. The selection of books for purchase is regulated by the needs of the scientific assistants. A suggestion book is kept, in which are entered by the various assistants the titles of works they desire; and selection is mainly confined to this list. An attempt is first made to secure such books by exchange, and in case of failure they are purchased.

The regulations for the use of the library are designed to make it as serviceable as possible to the scientific assistants of the survey and to geologists in general. All who wish to consult the library are permitted to take books from the shelves, and all members of the survey are allowed to draw such books as they wish from the library for such periods as their work requires. At all times, several thousand volumes are in the work rooms of the various assistants, and about one thousand volumes are drawn and returned each month. The privilege of borrowing books has been accorded to numerous individuals outside the survey, and although such privilege is discretionary, and may be withheld from any individual or with reference to any book, so few exceptions have arisen that it may fairly be said that the library is fully at the service of the scientific public.

The system adopted by the librarian of the survey for recording the loan and return of books enables him to determine immediately whether a given book has been loaned, and, if so, to whom, or what books a given individual has received. The first is shown by a card, which is at once a request and a receipt, signed by the person obtaining a book.

This is filed in alphabetic order, under the name of the author given upon it. The second is shown by an entry of the author's name from these autograph receipts, upon a different card, which is filed under the name of the person signing the receipt, and bears the names of all authors whose works have been borrowed by him, together with the date of his receipts for each. Samples of these two cards are appended:

UNITED STATES GEOLOGICAL SURVEY,
Washington, D. C., ——— —, 188–.

Received from the library of the U. S. Geological Survey the following work:

Author.	Title.	Vols.	Date.

Name: ——— ———,
Address: ——— ———.

Applicant will write one title only on this card.
Librarian will return the card if the work is not sent, or when the work is returned.

Smith (John.)

13247 Geikie	24-7-85						
9682 Lyell	31-7-85						
11763 Darwin	18-8-85						

RÉSUMÉ.

In the fiscal system which has been presented it will be seen that documentary evidence is preserved of every disbursement, however small, fully explaining the nature and purpose of the transaction, and that this evidence is kept in such a manner that each transaction may be called up and re-examined with the least possible delay, and that responsibility for each transaction can at once be fixed.

In the custodial system every piece of property purchased is accounted for, and with the least possible labor and delay it can be determined whether such property has been expended, lost, destroyed, sold, or remains on hand, and if on hand who is responsible for its custody.

Of the property produced, such as maps, reports, &c., the document system clearly sets forth to whom distribution has been made and for what consideration, and the system is completed by setting forth what remains on hand.

The entire business system, as thus set forth, has been made as simple as is compatible with the distribution and identification of responsibility. In order that members of the Survey may understand their duties relating to disbursements and the custody of property, a book of "regulations" has been prepared, fully setting forth the business system; and when an assistant receives orders for the prosecution of any line of work which involves money or property responsibility, his instructions call attention to the proper paragraphs of the "regulations."

I have endeavored to explain those parts of the business system of the survey which are supposed to be of chief interest to the Commission because they involve responsibility for money and property. There are other lines of business which greatly affect the general efficiency of the bureau, though they do not affect the responsibilities mentioned. These are (1) the editorial system, *i. e.*, the method of preparing reports; (2) the illustration system, *i. e.*, the method of selecting, preparing, and duplicating illustrations; (3) the statistical system, *i. e.*, the method of collecting, tabulating, and discussing the statistics of the mineral products of the United States; and (4) the correspondence system, *i. e.*, the method of conducting and preserving a record of all the correspondence of the bureau.

On each of these departments of the business much thought, experimentation, and labor have been expended, the result of which has been the development of plans and methods which seem to be satisfactory. I have prepared statements setting forth the several systems, and can present them to the Commission if desired, but suppose that the members of the Commission would hardly wish to be burdened with a detailed statement of the management of that part of the business.

The fiscal and custodial systems which I have described cost from 3¼ to 3½ per cent. of the total appropriation disbursed in the office of the Geological Survey, *i. e.*, the disbursement of the money, the rendition and examination of accounts, and the preparation of quarterly returns of property by custodians cost that amount.

It will be seen that the Geological Survey has adopted a system of paying actual expenses, instead of commuting traveling expenses. The total cost of disbursing and accounting for disbursements and property, as previously mentioned, is somewhat larger than it would be if a commutation system had been adopted, *i. e.*, if a per diem to cover field expenses were allowed. A commutation system would also be less onerous to assistants in the field. They would be saved the trouble of taking many small vouchers. There is therefore in this respect a disadvantage in a system which must necessarily be so elaborate and minute as to cover every expenditure. Much may be said in favor of a system of commutation, and much likewise may be said in favor of a system of paying actual expenses.

The Coast Survey has been severely criticised in the newspapers for the last few months because it has adopted a commutation system. I think such criticism unfair. The law provides for a commutation system (and there is nothing in it *per se* which is wrong). Everything depends upon the way in which it is administered; and there are many difficulties in the way of administering it satisfactorily. It can never be managed so as to secure substantial justice to the parties themselves and to the Government at the same time. Expenses one day are greater than another; expenses in one district of the country are greater than in others; and the expenses of one man differ from those of another because of his habits, etc., and it is apt to breed disaffection among the members of a traveling corps. Still, if it is administered wisely and with integrity, it has some evident advantages, and under such circumstances it may be more economic. A system of paying actual expenses has these advantages: First, the officers administering it are less subject to criticism; second, it probably secures better work, for if a man must pay his own expenses he will sometimes delay his work or sacrifice time when emergencies arise that require special expenditures; and third, in the keeping of these accounts accurate business habits and a thorough sense of responsibility are cultivated.

By Mr. MORGAN:

Q. You have shown us a map here in which you display some topographic work, and, I suppose, also geologic work; or is it topography entirely?

A. It is a mere base map or skeleton, upon which the areas which have been surveyed topographically are designated by colors.

Q. You claim that to be a map of the United States?

A. Yes, sir, in one sense; a skeleton map.

Q. Including a part of Mexico and a part of Canada, our neighboring countries?

A. Yes, sir.

Q. Where did you get that map?

A. It was compiled originally for the Census Bureau.

Q. From what did you compile it?

A. From a great variety of sources; it would be a long story to give you all of them. Several hundred original sources were consulted.

Q. This represents the configuration and dimensions of the United States in every direction?

A. Yes, sir; imperfectly.

Q. As well as its political divisions?

A. Yes, sir; but not with any great degree of accuracy.

Q. Then we have no official map of the United States defining its frontiers in respect to foreign nations, except, perhaps, on the coast?

A. No, sir; no general map of the United States which gives its proper relations to other countries.

Q. Likewise we have no official map showing the boundaries of the political divisions of the United States?

A. No, sir; not with any degree of accuracy.

Q. Nor of the Territories and the District of Columbia?

A. No, sir; only so far as the topographic work of the Geological Survey has progressed.

Q. We have no complete official map showing either the outline of our territory on land or sea, or showing the boundaries of the political divisions within the domain?

A. That is true.

Q. And the work on which the Geological Survey is engaged is really supplying all the want, if it is a want, of an official map of the United States?

A. Yes, sir.

THE PUBLICATIONS OF THE GEOLOGICAL SURVEY.

The publications of the U. S. Geological Survey are issued in accordance with the statute, approved March 3, 1879, which declares that—

> The publications of the Geological Survey shall consist of the annual report of operations, geological and economic maps illustrating the resources and classification of the lands, and reports upon general and economic geology and paleontology. The annual report of operations of the Geological Survey shall accompany the annual report of the Secretary of the Interior. All special memoirs and reports of said survey shall be issued in uniform quarto series if deemed necessary by the Director, but otherwise in ordinary octavos. Three thousand copies of each shall be published for scientific exchanges and for sale at the price of publication; and all literary and cartographic materials received in exchange shall be the property of the United States and form a part of the library of the organization: And the money resulting from the sale of such publications shall be covered into the Treasury of the United States.

On July 7, 1882, the following joint resolution, referring to all Government publications, was passed by Congress:

That whenever any document or report shall be ordered printed by Congress, there shall be printed, in addition to the number in each case stated, the "usual number" (1,900) of copies for binding and distribution among those entitled to receive them.

Under these general laws it will be seen that none of the survey publications are furnished to it for gratuitous distribution. The 3,000 copies of the Annual Report are distributed through the document rooms of Congress. The 1,900 copies of each of the publications are distributed to the officers of the legislative and executive departments and to stated depositories throughout the United States.

Except, therefore, in those cases where an extra number of any publication is supplied to this office by special resolution of Congress, as has been done in the case of the Second, Third, Fourth, and Fifth Annual Reports, or where a number has been ordered for its use by the Secretary of the Interior, as in the case of Mineral Resources and the Dictionary of Altitudes, the Survey has no copies of any of its publications for gratuitous distribution.

ANNUAL REPORTS.

Of the Annual Reports there have been already published:

I. First Annual Report to the Hon. Carl Schurz, by Clarence King. 1880. 8°. 79 pp. 1 map.—A preliminary report describing plan of organization and publications.

II. Report of the Director of the United States Geological Survey for 1880–'81, by J. W. Powell. 1882. 8°. lv, 588 pp. 61 pl. 1 map.

III. Third Annual Report of the United States Geological Survey, 1881–'82, by J. W. Powell. 1883. 8°. xviii, 564 pp. 67 pl. and maps.

IV. Fourth Annual Report of the United States Geological Survey, 1882–'83, by J. W. Powell. 1884. 8°. xii, 473 pp. 85 pl. and maps.

The Fifth and Sixth Annual Reports are in press.

MONOGRAPHS.

Of the Monographs, Nos. II, III, IV, V, VI, VII, and VIII are now published, viz:

II. Tertiary History of the Grand Cañon District, with atlas, by Clarence E. Dutton, Capt. U. S. A. 1882. 4°. xiv, 264 pp. 42 pl. and atlas of 24 sheets folio. Price $10.12.

III. Geology of the Comstock Lode and the Washoe District, with atlas, by George F. Becker. 1882. 4°. xv, 422 pp. 7 pl. and atlas of 21 sheets folio. Price $11.

IV. Comstock Mining and Miners, by Eliot Lord. 1883. 4°. xiv, 451 pp. 3 pl. Price $1.50.

V. Copper-bearing Rocks of Lake Superior, by Roland D. Irving. 1883. 4°. xvi, 464 pp. 15 l. 29 pl. Price $1.85.

VI. Contributions to the Knowledge of the Older Mesozoic Flora of Virginia, by Wm. M. Fontaine. 1883. 4°. xi, 144 pp. 54 l. 54 pl. Price $1.05.

VII. Silver-lead Deposits of Eureka, Nevada, by Joseph S. Curtis. 1884. 4°. xiii, 200 pp. 16 pl. Price $1.20.

VIII. Paleontology of the Eureka District, by Charles D. Walcott. 1884. 4°. xiii, 298 pp. 24 l. 24 pl. Price $1.10.

The following are in press, viz:

IX. Brachiopoda and Lamellibranchiata of the Raritan Clays and Greensand Marls of New Jersey, by Robert P. Whitfield. 1885. 4°. ix, 338 pp. 35 pl.

X. Dinocerata. A Monograph of an Extinct Order of Gigantic Mammals, by Othniel Charles Marsh 1885. 4°. — pp. 56 pl.

XI. Geological History of Lake Lahontan, a Quaternary Lake of Northwestern Nevada, by Israel Cook Russell. 1885. 4°. xiv, 288 pp. 46 pl.

XII. Geology and Mining Industry of Leadville, with atlas, by S. F. Emmons.

The following are in preparation, viz:

I. The Precious Metals, by Clarence King.

— Geology of the Eureka Mining District, Nevada, with atlas, by Arnold Hague.

— Lake Bonneville, by G. K. Gilbert.

— Sauropoda, by Prof. O. C. Marsh.

— Stegosauria, by Prof. O. C. Marsh.

— Geology of the Quicksilver Deposits of the Pacific Slope, with atlas, by George F. Becker.

— The Penokee-Gogebic Iron-Bearing Series of North Wisconsin and Michigan, by Roland D. Irving.

— Description of New Fossil Plants from the Dakota Groups, by Leo Lesquereux.

— Younger Mesozoic Flora of Virginia, by William M. Fontaine.

— Report on the Denver Coal Basin, by Samuel F. Emmons.

— Report on Ten-Mile Mining District, Colorado, by Samuel F. Emmons.

— Report on Silver Cliff Mining District, by Samuel F. Emmons.

— Flora of the Dakota Group, by J. S. Newberry.

BULLETINS.

The Bulletins of the Survey will contain such papers relating to the general purpose of its work as do not properly come under the heads of Annual Reports or Monographs.

Each of these Bulletins will contain but one paper and will be complete in itself. They will, however, be numbered in a continuous series, and will in time be united into volumes of convenient sizes. To facilitate this, each Bulletin will have two paginations, one proper to itself and another which belongs to it as part of the volume.

Of this series of Bulletins Nos. 1 to 26 are already published, viz:

1. On Hypersthene-Andesite and on Triclinic Pyroxene in Augitic Rocks, by Whitman Cross, with a Geological Sketch of Buffalo Peaks, Colorado, by S. F. Emmons. 1883. 8°. 42 pp. 2 pl. Price 10 cents.

2. Gold and Silver Conversion Tables, giving the coining value of troy ounces of fine metal, etc., by Albert Williams, jr. 1883. 8°. ii, 8 pp. Price 5 cents.

3. On the Fossil Faunas of the Upper Devonian, along the meridian of 76° 30′, from Tompkins County, New York, to Bradford County, Pennsylvania, by Henry S. Williams. 1884. 8°. 36 pp. Price 5 cents.

4. On Mesozoic Fossils, by Charles A. White. 1884. 8°. 36 pp. 9 pl. Price 5 cents.

5. A Dictionary of Altitudes in the United States, compiled by Henry Gannett. 1884. 8°. 325 pp. Price 20 cents.

6. Elevations in the Dominion of Canada, by J. W. Spencer. 1884. 8°. 43 pp. Price 5 cents.

7. Mapoteca Geologica Americana. A catalogue of geological maps of America (North and South), 1752–1881, by Jules Marcou and John Belknap Marcou. 1884. 8°. 184 pp. Price 10 cents.

8. On Secondary Enlargements of Mineral Fragments in Certain Rocks, by R. D. Irving and C. R. Van Hise. 1884. 8°. 56 pp. 6 pl. Price 10 cents.

9. A Report of work done in the Washington Laboratory during the fiscal year 1883–'84. F. W. Clarke, chief chemist; T. M. Chatard, assistant. 1884. 8°. 40 pp. Price 5 cents.

10. On the Cambrian Faunas of North America. Preliminary studies, by Charles Doolittle Walcott. 1884. 8°. 74 pp. 10 pl. Price 5 cents.

11. On the Quaternary and Recent Mollusca of the Great Basin; with Descriptions of New Forms, by R. Ellsworth Call; introduced by a sketch of the Quaternary Lakes of the Great Basin, by G. K. Gilbert. 1884. 8°. 66 pp. 6 pl. Price 5 cents.

12. A Crystallographic Study of the Thinolite of Lake Lahontan, by Edward S. Dana. 1884. 8°. 34 pp. 3 pl. Price 5 cents.

13. Boundaries of the United States and of the several States and Territories, by Henry Gannett. 1885. 8°. 135 pp. Price 10 cents.

14. The Electrical and Magnetic Properties of the Iron-Carburets, by Carl Barus and Vincent Strouhal. 1885. 8°. 238 pp. Price 15 cents.

15. On the Mesozoic and Cenozoic Paleontology of California, by Dr. C. A. White. 1885. 8°. 33 pp. Price 5 cents.

16. On the higher Devonian Faunas of Ontario County, New York, by J. M. Clarke. 1885. 8°. 86 pp. 3 pl. Price 10 cents.

17. On the Development of Crystallization in the Igneous Rocks of Washoe, by Arnold Hague and J. P. Iddings. 1885. 8°. 44 pp. Price 5 cents.

18. On Marine Eocene, Fresh-water Miocene, and other Fossil Mollusca of Western North America, by Dr. C. A. White. 1885. 8°. 26 pp. 3 pl. Price 5 cents.

19. Notes on the Stratigraphy of California, by George F. Becker. 1885. 8°. 28 pp. Price 5 cents.

20. Contributions to the Mineralogy of the Rocky Mountains, by Whitman Cross and W. F. Hillebrand. 1885. 8°. 114 pp. 1 pl. Price 10 cents.

21 The Lignites of the Great Sioux Reservation, by Bailey Willis. 1885. 8°. 16 pp. 5 pl. Price 5 cents.

22. On New Cretaceous Fossils from California, by Charles A. White, M. D. 1885. 8°. 25 pp. 5 pl. Price 5 cents.

23. The Junction between the Eastern Sandstone and the Keweenaw Series on Keweenaw Point, by R. D. Irving and T. C. Chamberlin. 1885. 8°. 124 pp. 17 pl. Price 15 cents.

24. List of Marine Mollusca, comprising the Quaternary Fossils and recent forms from American localities between Cape Hatteras and Cape Roque, including the Bermudas, by W. H. Dall. 1885. 8°. 336 pp. Price 25 cents.

25. The Present Technical Condition of the Steel Industry of the United States, by Phineas Barnes 1885. 8°. 82 pp. Price 10 cents.

26. Copper smelting, by Henry M. Howe. 1885. 8°. 107 pp. Price 10 cents.

Numbers 1 to 6 of the Bulletins form Volume I; Numbers 7 to 14, Volume II; and Numbers 15 to 23, Volume III. Volume IV is not yet complete.

The following are in press, viz:

27. Work done in the Division of Chemistry and Physics during the years 1884–'85, by Prof. F. W. Clarke.

28. The Gabbros and Associated Hornblende Rocks occurring in the neighborhood of Baltimore, by George H. Williams.

29. On the Fresh Water Invertebrates of the North American Jurassic, by Dr. C. A. White.

30. On the Cambrian Faunas of Forth America, by Charles D. Walcott.

In preparation:

— Bibliography of North American Crustacea, by Lieut. A. W. Vogdes.

— Tertiary and Cretaceous Strata of the Tuscaloosa, Tombigbee, and Alabama Rivers, by Eugene A. Smith and Lawrence C. Johnson.

— On the Explosion at Flood Rock, by F. W. Clarke, T. C. Mendenhall, and H. M. Paul.

— Preliminary Essay on the Richmond Coal Field, by Israel Cook Russell.

— Mineral Springs of the United States, by Dr. Albert C. Peale.

— Types of the Laramie Flora, by Lester F. Ward.

— A contribution to the Areal Geology of the United States, by W J McGee.

STATISTICAL PAPERS.

A fourth series of publications, having special reference to the mineral resources of the United States, has been undertaken. Of that series the following have been published, viz:

Mineral Resources of the United States [1882], by Albert Williams, jr. 1883. 8°. xvii, 813 pp. Price 50 cents.

Mineral Resources of the United States, 1883 and 1884, by Albert Williams, jr. 1885. xiv, 1,016 pp. 8°. Price 60 cents.

In preparation:

Mineral Resources of the United States for calendar year 1885, by Albert Williams, jr.

DISTRIBUTION OF THE SCIENTIFIC AND FIELD EMPLOYÉS OF THE GEOLOGICAL SURVEY FOR THE QUARTER ENDING SEPTEMBER 30, 1885.

DIVISION OF GEOGRAPHY.

Names.	Occupations.	Salary.
Gannett, Henry	Geologist in charge	$3,000
Kübel, Edward	Mechanician	2,100
Rizer, Henry C	Disbursing agent	1,800

New England section of topography.

Names.	Occupations.	Salary.
Bodfish, Sumner H	Topographer	$2,000
Karl, Anton	do	2,000
Walling, Henry F	do	2,000
Johnson, Willard D	do	1,600
Vermeule, C. C	do	1,600
Dür, Charles	do	1,200
Natter, E. W. F	do	1,200
Phillips, Robert H	Assistant topographer	900
Thompson, Laurence	do	900
Bassett, Charles C	do	840
Jennings, James H	do	840

In addition to the above, there were employed in this section from time to time during the field season the following temporary assistants: 19 field assistants, 7 rodmen, 2 odometer readers, 1 draftsman, 1 office attendant.

South Atlantic section of topography.

Names.	Occupations.	Salary.
Thompson, Gilbert	Geographer	$2,500
Christie, Peter H	Topographer	1,800
Hoffmann, John D	do	1,800
Bien, Morris	do	1,600
Gannett, Samuel S	do	1,600
Griswold, William T	do	1,600
Nell, Louis	do	1,600
Pearson, Frank M	do	1,600
Yeates, Charles M	do	1,600
Knight, Frederick J	do	1,400
Hays, John W	do	1,200
Blair, Herbert B	Assistant topographer	1,000
Fletcher, Louis C	do	1,000
Maher, James A	do	1,000
Ahern, Jeremiah	do	900
Harrison, Dabney C	do	900
Howell, David J	do	900
Longstreet, Robert L	do	900
McKinney, Robert C	do	900
Barnard, Edward C	do	840
Hackett, Merrille	do	840
Murlin, Arlington E	do	840
Selden, Henry S	do	840
Towson, Richard M	do	840
Michler, R. McCarty	do	720
Oyster, Edward A	do	720

In addition to the above, there were employed in this section from time to time during the field season the following temporary assistants: 22 field assistants, 14 teamsters, 10 cooks, 3 barometer observers, 1 assistant barometer observer, 5 rodmen, and 1 computer.

Western section of topography.

Names.	Occupations.	Salary.
Thompson, Almon H	Chief geographer	$2,700
Douglas, Edward M	Topographer	1,800
Davis, Arthur P	do	1,600
Goode, Richard U	do	1,600
Kerr, Mark B	do	1,600
Wilson, Herbert M	do	1,600
Fitch, Charles H	do	1,400
Dunnington, Abner F	do	1,200
Ricksecker, Eugene	do	1,200
Peters, William J	Assistant topographer	1,000
Wallace, Hamilton S	do	1,000
Baldwin, Harry L., jr	do	900
Chapman, Robert H	do	840
Hawkins, George T	do	840
Holman, Paul	do	840
Perkins, Edmund T., jr	do	720

In addition to the above, there were employed in this section from time to time during the field season the following temporary assistants: 2 guides, 2 topographic assistants, 11 barometer assistants, 16 field assistants, 1 chief packer, 12 packers, 17 teamsters, 20 cooks, 1 observer, 1 level repairer, 1 herder, 1 axeman, 13 laborers, and 1 foreman of train.

Yellowstone Park section of topography.

Names.	Occupations.	Salary.
Renshawe, John H	Geographer	$2,500
Leffingwell, William H	Topographer	1,500
Tweedy, Frank	do	1,200
Aplin, Stephen A	Assistant topographer	900

In addition to the above, there were employed in this section from time to time during the field season the following temporary assistants: 5 field assistants, 1 chief packer, 5 packers, 4 cooks, 1 guide, and 1 laborer.

Section of astronomy.

Name.	Occupation.	Salary.
Woodward, Robert S	Geographer	$2,500

In addition to the above, there was employed in this section during the field season 1 field assistant.

Section of drafting.

Names.	Occupations.	Salary.
King, Harry	Draftsman	$1,600
Klemroth, John H	do	1,200
Noerr, Albert	Assistant topographer	1,000
Fiset, Franz	Draftsman	900
Würdemann, Harry V	do	900

DIVISIONS OF GEOLOGY.

Division of Archean Geology.

Names.	Occupations.	Salary.
Pumpelly, Raphael	Geologist	$4,000
Putnam, Bayard T	Assistant geologist	1,800
Taylor, Alex. O'D	Special disbursing agent	1,800
Wolff, John E	Assistant geologist	1,200

In addition to the above, there were employed in this division from time to time during the field season 1 field assistant, 1 bibliographer, 1 teamster.

Appalachian Division of Geology.

Names.	Occupations.	Salary.
Gilbert, Grove K	Geologist	$4,000
Sayles, Ira	do	2,400
Willis, Bailey	do	2,400
White, Israel C	do	2,000
Russell, Israel C	Assistant geologist	1,600
Geiger, Hezekiah R	do	1,500
Andrews, Edward H	do	840
Stein, Robert	Stenographer	900

In addition to the above, there were employed in this division from time to time during the field season 1 driver and rodman, 2 cooks, 1 field assistant, and 1 teamster.

Lake Superior Division of Geology.

Names.	Occupations.	Salary.
Irving, Roland D	Geologist	$3,000 00
Chauvenet, William M	Assistant geologist	*5 00
Daniells, William W	do	*5 00
Williams, George H	do	*5 00
Hall, Christopher W	do	*4 50
Van Hise, Charles R	do	*4 00
Merriam, William N	do	1,200 00

* Per day.

In addition to the above, there were employed in this division from time to time during the field season 4 packers, 1 cook, 2 packers and cooks, 1 clerical assistant, 1 draftsman, 1 woodsman, 1 field assistant, 1 arranger of specimens, and 1 boatman.

Division of Glacial Geology.

Names.	Occupations.	Salary.
Chamberlin, Thomas C	Geologist	$3, 600 00
Salisbury, Rollin D	Assistant geologist	*5 00
Stone, George H	do	*5 00
Todd, James E	do	*5 00
Wright, George F	do	*5 00
Upham, Warren	do	1, 200 00

*Per day.

In addition to the above, there were employed in this division from time to time during the field season 2 geologic assistants, 1 draftsman, and 1 field assistant.

Montana Division of Geology.

Names.	Occupations.	Salary.
Hayden, Ferdinand V	Geologist	$4, 000
Peale, Albert C	do	2, 000

Yellowstone Park Division of Geology.

Names.	Occupations.	Salary.
Hague, Arnold	Geologist	$4. 000
Iddings, Joseph P	Assistant geologist	1, 800
Davis, Charles D	do	1, 600
Weed, Walter H	do	1, 200
Wright, George M	do	1, 200

In addition to the above, there were employed in this division from time to time during the field season the following temporary assistants: 3 packers, 2 teamsters, and 2 cooks.

Colorado division of geology.

Names.	Occupations.	Salary.
Emmons, Samuel F	Geologist	$4, 000
Cross, Charles W	Assistant geologist	1, 600
Eldridge, George H	do	1, 600
Eakins, Lincoln G	do	900
Rogers, Alfred M	Disbursing agent	1, 500

In addition to the above, there were employed in this division from time to time during the field season the following temporary assistants: 2 field assistants, 2 packers, 2 janitors, 1 cook, 1 herder, 3 mechanics, and 3 laborers.

California division of geology.

Names.	Occupations.	Salary.
Becker, George F	Geologist	$4, 000
Melville, William H	Assistant chemist	1, 800
Hawkins, Richard R	Assistant geologist	1, 500
Lindgren, Waldemar	do	1, 400
Turner, Henry W	do	1, 400
Harvey, Miss Lucas	Copyist	720

In addition to the above, there were employed in this division from time to time during the field season the following temporary assistants: 1 assistant in laboratory, 2 rock chippers, 1 cook, and 2 laborers.

Volcanic division of geology.—Cascade Mountains.

Names.	Occupations.	Salary.
Dutton, Capt. Clarence E	Geologist in charge	(*)
Diller, Joseph S	Assistant geologist	$1,800

* No salary.

In addition to the above, there were employed in this division from time to time during the field season 2 clerical assistants.

Louisiana division of geology.

Name.	Occupation.	Salary.
Johnson, Lawrence C	Assistant geologist	$1,200

Division of cartographic geology.

Names.	Occupations.	Salary.
McGee, W J	Geologist	$2,000
Starek, Emil	Clerk	900

DIVISIONS OF PALEONTOLOGY.

Division of vertebrate paleontology.

Names.	Occupations.	Salary.
Marsh, Othniel C	Paleontologist	$4,000
Barbour, Erwin H	Assistant paleontologist	1,400
Bostwick, Thomas A	do	900
Hermann, Adam	do	900

In addition to the above, there were employed in this division from time to time during the field season 7 paleontologic assistants, 2 collectors with teams, and 2 collectors without teams.

Paleozoic division of invertebrate paleontology.

Names.	Occupations.	Salary.
Walcott, Charles D	Paleontologist	$2,000
Gentry, John W	Assistant paleontologist	1,200
Curtice, Cooper	do	1,000
Williams, Henry S	Assistant geologist	1,500

In addition to the above, there were employed in this division from time to time during the field season 1 collector and 1 field assistant.

Mesozoic division of invertebrate paleontology.

Names.	Occupations.	Salary.
White, Charles A	Geologist	$2,700
Marcou, John B	Assistant geologist	1,200
Burns, Frank	do	900
Hill, Robert T	Paleontologic assistant	600

In addition to the above, there was employed in this division during the field season 1 field assistant.

Cenozoic division of invertebrate paleontology.

Names.	Occupations.	Salary.
Dall, William H	Paleontologist	$2,000
Stearns, Robert E. C	do	2,000

DIVISION OF PALEOBOTANY.

Names.	Occupations.	Salary
Ward, Lester F	Geologist	$2,000
Hayden, Edward E	Paleontologic draftsman	1,200

The following geologists, paleontologists, and paleobotanists are employed from time to time for short periods, as scientific experts, at the following rates:

Names.	Occupations.	Salary.
Cook, George H	Geologist	(*)
Safford, James M	Assistant geologist	$1,800
Hall, James	Paleontologist	(*)
Newberry, John S	do	3,600
Fontaine, William M	do	2,000

* No salary.

DIVISION OF CHEMISTRY AND PHYSICS.

Names.	Occupations.	Salary
Clarke, Frank W	Chemist	$3,000
Gooch, Frank A	do	2,000
Hillebrand, William F	do	2,000
Chatard, Thomas M	Assistant chemist	1,500
Whitfield, James E	do	1,200
Riggs, Robert B	do	1,000
Barus, Carl	Assistant geologist	1,800
Hallock, William	do	1,600

DIVISION OF STATISTICS.

Names.	Occupations.	Salary
Williams, Albert, jr	Geologist	$2,400
Raborg, William A	Assistant geologist	1,200
Middleton, Jefferson	Clerk	900

SCIENTIFIC EXPERTS EMPLOYED BY THE GEOLOGICAL SURVEY FROM JUNE 30, 1883, TO SEPTEMBER 30, 1885.

APPALACHIAN DIVISION OF GEOLOGY.

Name.	Designation.	Period.		Amount paid.
		From—	To—	
Call, R. Ellsworth	Preparing Report on Fresh Water Shells of the Great Basin.	July 19, 1884		$300 00
Dana, Edward S.	Investigation and report on thinolite.	Oct. 21, 1884		150 00
Dauris, Thomas	Observations on water-level of Great Salt Lake.	Dec. 8, 1884		15 00
Do	Observations at Garfield Landing, Lake Gauge.	Oct. 1, 1884	June 30, 1885	9 00
Emerton, J. H.	Making thirty eight drawings of crystals and sections of thinolite.	Aug. 22, 1884		42 00

CALIFORNIA DIVISION OF GEOLOGY.

Craig, Thomas	Special services in mathematical physics, arising in field geology.	Apr. 27, 1885		$50 00

COLORADO DIVISION OF GEOLOGY.

Jirdinston, W. C	Projecting, compiling, and drawing eight maps and one geologic section for report.	July 2, 1883	Sept. 29, 1883	$456 00

MESOZOIC DIVISION OF INVERTEBRATE PALEONTOLOGY.

Ryder, J. F	Preparation of paper for the Annual Report of the Director of the Survey.	Mar. 5, 1884		$50 00

GENERAL OFFICE.

Hitchcock, C. H.	Compiling and coloring geologic map.	Dec. 1, 1883	Jan. 12, 1884	300 00
Whitfield, R. P.	Preparing fifty-four drawings and twenty descriptions for same, also ten descriptions for monograph on "Lamellibranchiata."	Aug. 5, 1884		408 00
Do	Preparing forty-two original drawings and twenty original descriptions for monograph on "Gasteropoda."	Oct. 27, 1884		$284 00
Do	Preparing fifty-four drawings and twenty-four descriptions for same.	Dec. 2, 1884		348 00
Do	Preparing ninety-five drawings and twenty-five descriptions for same.	Mar. 11, 1885		440 00
Do	Preparing ninety-seven drawings and twenty-seven descriptions for same.	July 15, 1885		464 00
Do	Preparing fifty drawings and twenty descriptions for Gasteropoda.	Sept. 25, 1885		300 00

DIVISION OF MINING STATISTICS.

Summary of expenditures of Division of Mining Statistics to July 1, 1885.

Fiscal years.	Amount.
1882-'83	$6,780 13
1883-'84	2,648 15
1884-'85	7,689 71
Total	17,117 99

Cost of preparation of "Mineral Resources of the United States" [1882].—*Allotment for fiscal year* 1882-'83.

Names.	For what paid.		Amount.
C. Kirchhoff, jr	Copper statistics		$200 00
Do	Lead and zinc statistics		150 00
John C. Smock	Compilation of mineral localities		200 00
Otto A. Moses	Phosphate rock statistics		100 00
F. E. Saward	Coal statistics		300 00
S. H. Stowell	Petroleum statistics		200 00
W. P. Blake	Preparing chapter on nickel		250 00
C. G. Yale	Pacific coast statistics (special agent)		200 00
John C. Wetmore	Compiling mining accidents		30 00
J. E. Gignoux	Article on wet copper process		40 00
F. F. Chisolm	Rocky Mountain statistics (special agent)		200 00
E. W. Hilgard	Article on the Louisiana salt mines		35 00
M. C. Read	Article on Berea grit		15 00
E. A. Smith	Article on Alabama iron ores		25 00
D. B. Huntley	Arizona and Utah mineral statistics (special agent)		60 00
J. M. Swank	Iron and steel statistics		300 00
R. W. Raymond	Article on the divining rod		100 00
W. E. Hidden	Articles on American emeralds and hiddenite		25 00
F. L. Clerc	Article on the zinc industry		125 00
J. A. Walker	Graphite chapter		100 00
C. W. Sweet	Statistics of bricks, cement, lime, and gypsum		25 00
J. Douglas, jr.	Article on copper metallurgy		86 40
E. D. Peters, jr	Article on roasting of copper ores		55 00
E. Daggett	Article on Utah coal mines		40 00
R. A. Keeler	Statistics of mica, feldspar, &c		25 00
G. B. Chittenden	Statistics of buhrstone, lithographic stone, corundum, copperas, bluestone, salt, &c.		125 00
C. A. Ashburner	Anthracite statistics		100 00
E. Stahl	Compilation of mineral localities		20 00
D. T. Day	Statistics of manganese, chromium, and tungsten		78 00
C. O. Mailloux	Article on electro-metallurgy		33 00
F. A. Wilber	Statistics of marls, clay, apatite, &c		150 00
H. Degroot	Miscellaneous mineral statistics		80 00
J. Perkins	Compiling mineral localities		20 00
O. H. Hahn	Article on lead smelting		80 00
			3,572 40
E. M. Parkman	Type-writing (job)	$95 70	
Various persons	Clerical work (job)	760 63	
	Periodicals and office furniture	184 02	
Albert Williams, jr.	Salary, at $2,400 per annum	1,995 60	
	Traveling expenses	171 78	
			3,207 73
	Total		6,780 13

Expenditures in fiscal year 1883-'84.

[No allotment was made for the publication of a special report for the calendar year 1883, though work was continued with a view to issuing a report for the calendar years 1883 and 1884 together, an allotment of $8,000 for the fiscal year 1884-'85 having been arranged for. The following expenses were in connection with the proof-reading and distribution of the first report, routine office-work, and classification of volcanic rocks.]

Type-writing (job)	$28 45
Clerical work (job)	219 70
Salary, Albert Williams, jr	2,400 00
	2,648 15

Cost of preparation of "Mineral Resources of the United States, calendar years 1883 *and* 1884."—*Allotment for fiscal year* 1884–'85.

Names.	For what paid.		Amount.
M. W. Iles	Article on lead slags		$80 00
W. C. Stubbs	Article on Alabama phosphates		35 00
F. A. Wilber	Statistics of clays, marls, apatite, and gypsum		150 00
Do	Revising and correcting manuscript		25 00
William Martyn	Pyrites statistics		75 00
W. L. Dudley	Article on iridium		30 00
H. M. Howe	Article on copper smelting (Bulletin 26)		250 00
E. D. Peters, jr	Article on Butte mines and works		105 00
H. O. Hofman	Article on lead desilverizing		55 00
John Birkinbine	Article on blast furnace progress		100 00
W. S. Jarboe	Natural gas statistics		150 00
H. M. Chance	Article on anthracite mining		150 00
E. W. Hilgard	Article on asphaltum		50 00
R. W. Raymond	Article on mining law		100 00
G. F. Kunz	Statistics of precious stones		100 00
D. T. Day	Statistics of chromium and cobalt		100 00
Do	Statistics of feldspar, manganese, phosphate rock, fertilizers, bromine, iodine, zirconium, and tungsten.		200 00
Do	Miscellaneous statistics and revision of manuscript		66 00
C. G. Yale	Pacific coast statistics (special agent)		300 00
J. A. Walker	Graphite statistics		50 00
P. Barnes	Steel industry of the United States (Bulletin 25)		150 00
S. M. Buck	Article on coal mining in the Kanawha Valley		60 00
F. F. Chisolm	Rocky Mountain statistics (special agent)		300 00
J. Douglas, jr.	Article on copper smelting in Arizona		40 00
C. Kirchhoff, jr	Copper statistics		200 00
Do	Lead and zinc statistics		250 00
Do	Revision of manuscript		8 50
W. Bredemeyer	Collecting Utah statistics		40 00
H. S. Sproull	Statistics of building stone, cement, &c		50 00
H. Degroot	Statistics of borax, salt, &c		100 00
D. B. Huntley	Collecting Arizona statistics		40 00
J. M. Swank	Iron and steel statistics		300 00
W. P. Blake	Statistics of tin, nickel, and antimony		150 00
C. K. Mills	Statistics of barytes, lithographic stone, asbestus, &c		120 00
M. Benjamin	Statistics of mineral paints		50 00
J. D. Weeks	Statistics of coke and glass materials		200 00
S. C. Armstrong	Coal statistics		250 00
S. H. Stowell	Petroleum statistics		200 00
			4,679 50
E. M. Parkman	Type-writing (job)	$71 35	
E. N. Noble	Services as stenographer (job)	15 00	
J. C. Parker	Periodicals, directories, rubber stamps, &c	360 25	
T. L. Clacher	Pamphlet boxes	32 75	
W. B. Moses	Desk	78 00	
Albert Williams, jr	Salary	2,400 00	
W. B. Moses	Sundries	52 86	
			3,010 21
	Total		7,689 71

Mr. HERBERT (referring to the tabulated statement relating to scientific experts). Please explain fully why each of the experts you have mentioned were employed.

Major POWELL. Mr. Ellsworth Call, who received $300 for preparing a "Report on the Fresh Water Shells of the Great Basin" in 1884, was employed because he had previously studied in that branch of science. There was in the Geological Survey no man who had made a specialty of that subject. Mr. Call had made it a specialty. He has since been employed by Professor Baird in the National Museum.

Mr. Edward S. Dana was paid $150 for an investigation and report on thinolite. Thinolite is a mineral found in very large quantities in many different localities, chiefly in Nevada, and Professor Dana was selected to report on this subject, as he had previously studied it, and was the only man in the United States at that time who was at once prepared to take it up.

Mr. Thomas Dauris was paid $21 for observations on the level of the Great Salt Lake. He lived on the shore of the lake, and it was more economic to have him make the observations than to send some person there.

Mr. J. H. Emerton was paid $42 for making drawings of crystals and sections of thinolite.

By Mr. HERBERT:

Q. You say he lived in New Haven?

A. Yes, sir.

Q. What was his occupation?

A. He was a microscopic draftsman.

Q. You had no draftsman for that kind of work?

A. The drawing of microscopic crystals is a specialty in which few persons engage. At that time such a draftsman was not in the employ of the survey, and Mr. Emerton's services were necessary. Moreover, the drawings were necessarily made under Mr. Dana's immediate supervision, and it was more economic to employ a draftsman in New Haven than to transport one thither.

Mr. Thomas Craig received $50 for special services in mathematical physics.

Mr. HERBERT. Who is Thomas Craig?

A. He is associate professor of applied mathematics in Johns Hopkins University. Mr. Becker, who has charge of the work in California, desired to have certain mathematical propositions solved. He had a theory that referred to the origin of the curves of the volcanic slopes, and discussed this theory by mathematical methods. When it was sent to me I submitted it to Professor Newcomb, who recommended me to submit it to Professor Craig.

Q. Why did you go in the first place to Professor Newcomb?

A. Because Professor Newcomb is an eminent mathematician and physicist. Scientific work has been differentiated into many specialties, and Professor Newcomb is a specialist in this field; but he was not paid for his services.

Mr. HERBERT. Why was Mr. Jirdinston employed?

A. Mr. Emmons has charge of the work in Colorado and the Geological Survey had a sub-office in Denver. The work done by Mr. Jirdinston could have been done in Washington had Mr. Emmons come to Washington to supervise it; but it would have been necessary to employ a man to do it here, and a man could be employed in Denver, Colo., as cheaply as in Washington, and the expense in bringing Mr. Emmons to Washington was saved.

Major POWELL continued: Mr. Ryder was engaged to prepare a paper for the annual report of the Survey, for which he was paid $50. In that report was a paper by Dr. White, one of the paleontologists of the Survey, and the work of Mr. Ryder was supplemental to that of Dr. White.

Mr. Whitfield has received various sums during the past two and a half years, and was engaged because he was a specialist in that class of fossils submitted to him. He is an eminent scholar, and one of the highest authorities in the world on that subject.

In December, 1883, Prof. Charles H. Hitchcock, of Dartmouth College, was engaged to assist Mr. McGee, of the Geological Survey, in compiling a map of the United States representing the work of State and other geologists, in order to prepare a "progress map," or a map showing all the work done up to date. Professor Hitchcock was an expert in this matter and had previously devoted a great deal of time to the subject, and several years ago published such a map; but it was not brought up to date, and much additional work was necessary.

The list which I have given embraces all the experts who were employed on the Geological Survey, and who have not received their appointments from the Secretary of the Interior.

There are a few persons who have worked but a part of their time on the Geological Survey, but who have received appointments from the Secretary of the Interior to do such work as may be called for from time to time, and such persons are reported as employés of the Survey in the Register. There are still others; a very long list of persons employed by the Geological Survey in the division of statistics. These men are scattered all over the United States, and many are paid small sums for collecting statistics and preparing material for the volume entitled "The Mineral Resources of the United States." Their names have been tabulated above, and the sums paid to them charged to the cost of preparing the report on mineral resources for 1883 and 1884.

By the CHAIRMAN:

Q. What class of statistics?

A. Statistics of the production of mines.

Q. What sums are expended per annum?

A. A little over $7,000; to a large extent paid out in small amounts.

Q. You have a regular salaried employé in charge of that division?

A. Yes, sir.

Q. What is he paid?

A. Twenty-four hundred dollars.

Q. Is that included in the $7,000?

A. Yes, sir.

By Mr. HERBERT:

Q. There was somewhere in your previous testimony quite a long list of persons given by you who were said to be employed to do work here and there for the Survey, and the inquiry was intended, I suppose, to reach that class of people?

A. Yes, sir; I think I enumerated quite a long list, and included in that list persons employed in collecting statistics, and I also included the persons employed under appointment by the Secretary when such persons did not give their whole time to the Survey.

Q. I will ask you how Professor Marsh was employed?

A. He is on the regular force, and is paid a salary of $4,000 a year. He devotes his entire time to the work, has a number of assistants, as I have previously set forth, and the work of himself and assistants is partly in the field and partly in the office.

Q. Do you not employ here and there a number of professors, sometimes from one college and sometimes from another, to do this bit of work and that bit of work?

A. All of the persons employed have been put upon one or the other of the lists which I have furnished. I do not include any person whose appointment was from the Secretary of the Interior on this list.

Q. Major, I would like to get at this information: I want to know what persons you employ who are employed elsewhere than in your bureau, either professors in colleges or in other occupations.

A. I will again enumerate those whose names occur on the list of regular employés, in such order as they come to my memory: Professor Hall, the State geologist of New York, has an appointment; he has done some work in systematizing the materials which relate to the geology of New York, but has received no pay therefor. Professor Cook, the State geologist of New Jersey, has an appointment by the Secretary in order that he may sign certain papers. He is engaged in the geological survey of New Jersey, and he supervises certain work for the

Geological Survey of the United States, but receives no salary therefor. He certifies to the accounts of certain persons who work under him, and in order that such certification should be legal, it was necessary to give him an appointment, and for him to take the oath of office. Professor Shaler, of Harvard University, is also on the list, as I have previously explained. Professor Safford, of Vanderbilt University, Nashville, Tenn., who was formerly State geologist of Tennessee, has received an appointment in the United States Geological Survey, to do a certain piece of work in that State with which he is familiar, and which can be done better and more economically by him than by any other person, but he has only fairly begun the work and has received no pay.

Q. Prof. R. D. Irving has charge of the work on Lake Superior?

A. Yes, sir.

Q. Who is he?

A. He was originally on the survey of Wisconsin.

Q. Is he permanently in the Geological Survey?

A. Yes, sir.

Q. Have you enumerated all, now?

A. Not all; Professor Newberry, of Columbia College, has an appointment from the Secretary as a paleontologist of the Survey. His case is rather a peculiar one; he receives a salary in Columbia College of $7,500, and he is one of the most eminent geologists and paleontologists in the United States, or in the world. He has done much work for the Government in former years, and he now has charge of certain work on paleontology for the Geological Survey, and he receives a salary for the days he is engaged in work at the rate of $3,600 per year; but practically that does not pay him for any time of his own. The facts in the case are these: He gives all of his time and uses his pay which he receives from the U. S. Geological Survey to employ assistants, and to pay his own traveling expenses, so that the Government does not pay for his assistants and traveling expenses direct.

Q. You name certain geologic parties made up of persons who take the field to do paleontology and paleobotany. Does the geologic party aid in the paleontologic work?

A. The geologic parties in the field collect fossils; the fossils are turned over to the paleontologist to study. The geologists also collect minerals and rocks, and they are turned over to the mineralogist or chemist for study. The geologists are not supposed to be expert in paleontology or paleobotany. But more than that, when localities containing fossils are found by geologists, the paleontologists sometimes, if found necessary, go to these localities and collect fossils, as they are more expert in the collection of fossils than are the geologists themselves.

Q. So that generally those who study and write upon paleontology and paleobotany simply study up the objects which are brought in to them?

A. Yes, sir; except when they go out themselves to make fossil collections.

Q. That is frequent?

A. Rather frequent.

Q. And when they go, do they collect material for the geologists also?

A. Yes, sir; to some limited extent.

Q. You were speaking awhile ago about a map; have you completed a map of any part of the United States, and, if so, for what portion is it absolutely complete?

A. The topography of a very large area is completed, say about 650,000 square miles; a geologic survey of large portions of the country is also completed.

Q. Can you mention any portion that is completed?

A. Oh, yes, sir; here is a geological map of the United States, so far as we know its geology. It is compiled, and exhibits what has been done by the United States and by State surveys, and persons studying geology under other auspices. Now, I should say that a large portion of the State of New York is well mapped, but the entire State of New York is not well mapped, and very much of the State of New York must be re-examined in order that the geology be completed upon a proper topographic map.

By the CHAIRMAN:

Q. The work has been improperly done?

A. The work has been incomplete, and is inaccurate in some respects.

By Mr. HERBERT:

Q. I am not speaking about that; for instance, I want to know whether you have completed any map of any part of the United States so that you do not expect to do any more to it? Name some portion of the United States which you have thus completed.

A. Some portions of Colorado, and some portions of Utah will not be re-examined, as the Survey is now organized and proceeding with its work.

Q. Then these maps are completed?

A. Yes, sir; they are practically complete, but not yet published; the materials are ready.

Q. Have you completed and published any map?

A. No, sir.

Q. Not even a square mile?

A. Oh, yes, sir; as I have explained to the Commission, there are certain districts requiring particular and elaborate study for certain reasons. Several maps of this kind have been published; for instance, a map of the Comstock lode; but of the general maps of the United States no sheets have yet been published, although thirteen sheets have been engraved; these are the sheets which I have presented before the Commission.

Q. I see you have published on the Comstock lode about five books, have you not—you and those who preceded you in the work?

A. The Geological Survey has published one by Becker, one by Eliot Lord, and a short bulletin by Hague and Iddings; and Mr. King also worked in that district, and published on the Comstock lode in his report of the survey of the fortieth parallel.

Q. Could not that work have been done just as well by an individual as by the Government?

A. I do not think that would have been done at all by individual enterprise; no individual has the plant for such an undertaking.

Q. What plant did Becker have for his investigation and report upon the Comstock lode that a private individual could not have?

A. A laboratory was needed, and a number of specialists had to be combined in such a work, each one doing a particular branch of the work in which he was an expert. I have to recall this matter somewhat vaguely to my mind, for the work was not originally planned and executed under my direction, but under the direction of my predecessor.

Q. The report was made to you?

A. Yes, sir. Let me say something about that work on the Comstock lode. The reason why so much has been done in the Comstock lode is this: Very often some particular locality is a key to the geologic structure of a great district. It chanced that the Comstock district was the key to the geology of a large area of country, and having worked out the structure of the geology of the Comstock district, the facts therein discovered can be used to great advantage elsewhere, just as it has happened that a locality in Canada was believed to be the key to the structure of the Archæan rocks of the Appalachian system, and some years ago the State geologist of North Carolina spent much time in Canada that he might work out the succession of rocks in that region and discover the principles that would lead to the classification of the rocks in North Carolina. Now, on the Comstock lode there are some 200 miles of galleries and shafts and systematically worked galleries at various depths down to 2,100 and 2,200 feet below the surface, and a district of country thus honeycombed for mining purposes presented an opportunity for thorough and careful research which could not be made at the surface anywhere in that region of country; the opportunity was seized to study the structural geology in these workings, and the study of the Comstock lode has proved a very fertile source of information for a large district of country.

Q. And is also a very fertile source of book-making?

A. Yes, sir; very much has been written upon the Comstock lode. There has been no piece of work done in the world of late years which has been more fertile in its results to economic geology and to structural geology than the work done on the Comstock lode.

Q. Now, please answer my question as to what plant Mr. Becker had in the work on that lode that a private individual could not have had?

A. By plant I meant the paleontologic and chemic laboratories necessary for the work, and also the group of expert assistants which was equally necessary.

Q. How many men did he have?

A. I do not at this moment remember definitely, as the work was not originally under my supervision; but say about six persons engaged as experts.

Q. The last work on that lode was by Eliot Lord?

A. Except the small bulletin by Hague and Iddings, yes, sir.

Q. Was that under you?

A. No, sir.

Q. That, as I understand it, in looking over it, is the history of that mining adventure, showing how it was discovered—by accident, and not by geologic research?

A. Yes, sir; how it was developed.

Q. And giving the history of the mining towns, etc.?

A. Yes, sir.

Q. That was published by you?

A. Yes, sir.

Q. What has that history to do with your work?

A. You make me do an unpleasant thing in calling upon me to criticize the work of my predecessor.

Q. But, Major, I feel like criticising this work, and want to be supported by the weight of your authority.

A. I should not have inaugurated the work.

Q. I do not understand you to have answered my question why private enterprise could not have done this work that the Government has done in examining, investigating, and reporting on the Comstock lode.

A. I think that if the Government had not undertaken this work, nobody else would have done it; no private individual could have afforded the expense necessary to have obtained the laboratories and combination of men that was engaged on that work. If the Government had not done the work it would not have been done, and if not done at once by the Government it would never have been done, for the galleries and shafts are, to a large extent, being abandoned and left to be closed up and become impassable by natural agencies, and it was necessary to enter the field of investigation just at the time it was done, and it would have been a great want of foresight not to have done the work at that time; and eventually it would have cost a much larger sum to have obtained the same information of the general structure of that country by other means; and, further, it is probable the surface work could not have been done in such a manner as to obtain the information which was obtained by studying the Comstock lode. In fact, it was substantial economy to the Government to make the survey as it did, because the geology of the district exhibited a vast system of workings which were the key to a very large district of country.

Q. Is Captain Dutton an officer of the Geological Survey?

A. Yes, sir.

Q. What is the work in which he is engaged?

A. He has charge of the volcanic division; he makes a special study of volcanic geology.

Q. By what authority did you send Captain Dutton to the Sandwich Islands to study the volcanic features?

A. I did not send him there.

Q. Who sent him there?

A. The Smithsonian Institution. The captain, as the chairman will remember, is detailed as an assistant in the Geological Survey, under authority of a specific statute. For many years the captain has been making a special study of volcanic geology, and as the volcanoes in the United States are extinct, I thought that Captain Dutton should visit some living volcanoes in order that he might more thoroughly understand this subject. The greatest living volcanoes in the world are in the Sandwich Islands, and I represented to Professor Baird, of the Smithsonian, that it was desirable to have Captain Dutton study these living volcanoes in order that he might apply the knowledge and principles gained there to the study of the extinct volcanoes in the United States, and especially of the Cascade Range, to which work he was to be assigned. I requested that he should be paid for this work out of the funds of the Smithsonian Institution, as I had no authority to send him with funds appropriated for the Geological Survey. Professor Baird laid the matter before the Regents of the Smithsonian Institution, and they provided means by which he could go, and paid his expenses.

Q. Has it been recently in contemplation to send Captain Dutton to Spain to study the quicksilver mines there?

A. No, sir; but Mr. Becker is engaged in studying quicksilver districts in California, which he has not completed, but when his work there is done, and he returns here, I shall probably ask the Smithsonian Institution to aid me in sending Mr. Becker to Spain to study the quicksilver mines of that country.

By Mr. MORGAN:

Q. Why not ask Congress to do it?

A. Well, it takes a good deal of time to present a matter of this kind to Congress, and to make full explanations of the necessity for such a course, and I think that Professor Baird and the Regents of the Smithsonian will at once see the value to science of sending Mr. Becker to study the mines of Almaden, which I believe have never been properly examined by scientific experts, and I have no doubt that such an examination will throw much light upon the occurrence of quicksilver in this country.

By Mr. HERBERT:

Q. Does it not occur to you that if there be any economic value in such a work as that, rich corporations, owning these quicksilver mines in America, would send a man on their own account?

A. I think that the "rich corporations" of America would not be willing to send a man to Spain to study the quicksilver mines of that country in order to throw light upon that subject for the purpose of publishing it to the world. In fact, the owners of the quicksilver mines in California were at first averse to our entering them, being fearful that we might publish information which they wished to keep within their own knowledge exclusively; but ultimately the superintendence of the mines fell into more intelligent hands, and permission to enter the mines was given, so that Mr. Becker and assistants not only examined the general geologic structure of the districts of country, but also the state of the mines themselves, in order to obtain the data necessary to a report on these districts, and some very interesting discoveries have been made by Mr. Becker in that country. In some of the districts the process of ore formation has been discovered, and in some of the mines ore is actually forming; that is, there is a segregation of ore in several districts.

Q. You recently published a monograph, I believe, on copper smelting?

A. No, sir; but I have recently published a short paper on this subject.

Q. How much?

A. About 100 pages.

Q. You had a man engaged in the study of that question?

A. Yes, sir.

Q. And intend to publish the result of his labors?

A. Yes, sir; it has been published.

Q. Is not that work that could be just as well done by individuals as by the Government?

A. It could have been done by a private individual if he was willing to do it.

Q. If it was worth doing, don't you think, or do you not think, that private individuals would do it?

A. No, sir; the investigation and the publication was not intended to add to the wealth of some particular individual, but to the general knowledge of the people of the United States—the best method of reducing certain ores.

Q. What relation has that to geology; if geology embraced that subject would it not just as well embrace watch-making?

A. I think not.

Q. Well, what is your reason?

A. Copper ores are found in large quantities largely scattered throughout the United States, in many States and Territories. A very small per cent. of such ore is worked. The working of copper ore depends, to a very large extent, upon the method which has been discovered in reducing it, and the important question is, how can these ores, known to exist in large quantities, widely scattered—how can they be utilized so as to be made to pay? The people who have already established mining operations are informed on this subject, and go on to utilize the ores which they are working, but thousands, or tens of thousands, or hundreds of thousands, who own copper ores, do not understand how they can utilize them, and it is desired to give such people the latest and best information, and such information is usually attached to the statistical volume———

Mr. HERBERT (interrupting). I do not doubt the usefulness of your information, but the question is, why should the Geological Survey go into things of that kind, which do not seem to properly belong to it. Is not that one reason why the appropriations have so rapidly run up until you make an estimate of $650,000 for the Survey for the coming year? You take in things that might be omitted.

By the CHAIRMAN:

Q. That comes out of your appropriation of $400,000, does it?

A. Yes, sir.

By Mr. HERBERT:

Q. Now, I want to get at the reasoning on which you justify the expansion of your work in that direction.

A. I am required by law to give the mineral resources of the country.

By the CHAIRMAN:

Q. The products?

A. The products.

Q. But the particular thing that I refer to is the short papers which show the progress made in metallurgy from year to year.

A. I am speaking about the investigations in that line; I suppose that they may cost from $1,500 to $2,000 annually. Those papers give, in connection with the statistics, a mass of information to the people which it is very desirable that they should have, and this volume is a very popular one in the United States. It has been reviewed by the press of the country everywhere, and the facts which have been gathered have been published to all of the people of the country through the newspapers. The information therein presented is spread broadcast far beyond the range of the distribution of the book itself. The daily and weekly press have published these things, but especially the mining press.

Mr. HERBERT. The question is whether you have the authority to do this work; if you have, you can enter, it seems to me, into anything else just as well, as, for instance, publishing works about watch-making or blacksmithing. I have no doubt about the interest taken in the work.

By Mr. MORGAN:

Q. The process of eliminating the metal from the ore is what you have dwelt on in this little book?

A. Yes, sir.

Q. What is the highest percentage of metal found in any ore, not speaking of native copper?

A. I would not like to answer that definitely from memory.

Q. Would not 10 per cent. ore be rich?

A. Yes, sir; as an average taken from very many mines.

Q. In the metallurgy of copper, the difficulty is to extract the copper with reasonable expense?

A. Yes, sir.

Q. Have you examined copper ores in the Territories of the United States?

A. Yes, sir.

Q. There are large tracts of ores throughout the country?

A. Yes, sir; especially in the Territories.

Q. That is what I supposed, or knew, in fact; then, for the benefit of the public, this would be valuable information, would it not?

A. Yes, sir.

Q. You give the most recent and improved processes of extracting this metal from copper ore?

A. Yes, sir.

Q. Have you undertaken to publish any methods in relation to iron?

A. To some extent.

Q. Have you entered into an analysis of iron ores for the purpose of determining their availability in the manufacture of steel?

A. Yes, sir; especially has this been done that we might eventually map the steel ores of the United States; that is, show their distribution throughout the country.

Q. Some persons have instituted electrical tests for the purpose of determining the difference between steel and iron; have you ever found any one who knows the distinction between iron and steel?

A. Yes, that has been determined in the laboratory of the Geological Survey, and published in Bulletin No. 14.

Q. Congress has appointed a commission to investigate that subject; do you know whether the commission has resorted to your Survey for the purpose of determining that question?

A. I have prepared a paper for that commission at its request.

Q. And you have derived your information from your labors in the field and from chemical analyses in your laboratory?

A. Yes, sir.

Q. That is an important matter, and I am glad the committee can get hold of it. There are large deposits of borax in the country, are there not?

A. Yes, sir.

Q. Who discovered the process of the formation of borax?

A. I do not now remember.

Q. Was he a member of your Survey?

A. It was a joint discovery; hardly the discovery of any one man; but the earlier discoveries in this country were made by members of the organization of the Geological Survey of California, and they have continued to the present time.

Q. Have you not investigated the actual process of the crystallization?

A. Yes, sir. The general study of borax began with the study of the old lakes of the far West which I previously mentioned.

Q. You came upon the fact that borax is in process of deposition in the United States?

A. Yes, sir.

Q. So that practically the supply of borax is inexhaustible?

A. Yes, sir.

Q. Is it not also true that the United States is one of the largest producers of borax in the world?

A. Yes, sir.

Q. Will not these discoveries greatly reduce the price of borax?

A. I think so.

Q. Have you not discovered in the Geological Survey that the soda found in the western country is in a state of preparation by act of nature, which takes from its cost of production in a commercial way something like one-third?

A. That I believe is true.

Q. In other words, you have found soda in the United States deposited by a natural process, and in such form that you have it at one-third the cost of soda found in Germany and other parts of the world?

A. That is what I think we can say.

Q. Have you any doubt about it?

A. Practically none.

Q. Are these areas large or small?

A. Very large. The whole area has not yet been traced out.

Q. How much has been traced out?

A. Many thousand square miles.

Q. And is it capable of extraction under the conditions I have named?

A. Yes, sir; in many localities.

Q. Now as to the discoveries in petroleum. Has your Survey led to information anywhere in regard to new petroleum fields?

A. To some extent new fields have been discovered, especially in Colorado. May I explain a little further?

Mr. MORGAN. Yes, go on.

A. The quantities of petroleum in the United States are enormous, with no possibility of exhaustion within any reasonable length of time; but the difficulty is that a very small per cent. of the petroleum can be used.

Q. For what purpose?

A. I am referring now to its utilization in making light. They do not yet know how to refine many of the petroleums, how to get them out of the crude state.

Q. You say it may be used for light?

A. Yes, sir. It may be used for other purposes. It will probably be used for a great variety of purposes for which it ought to be refined; and new methods for treating the oil must be discovered, as was the case with iron ores, which, once unavailable, became useful by combination with other ores, or in new metallurgical processes. Most of the petroleum is unavailable for the reason that methods for refining the crude material are not yet properly understood.

Q. Let me ask you upon that point. I understand you to say that the quantity of petroleum in the United States is immense?

A. Yes, sir; that is true when we consider the country at large.

Q. The geologic investigations being made, whether made by your survey or otherwise, I suppose will naturally lead to the discovery of those localities where petroleum can be made available through wells, or in some way?

A. Yes, sir. Large quantities of crude petroleum are known to exist at and near the surface in the far West.

Q. These discoveries, then, in that direction, are useful to the country?

A. Yes, sir.

Q. But you say that the difficulty is that our manufactories where it is used have not advanced to that stage where they can make them available?

A. Yes, sir. There is a very large body of crude petroleum that cannot yet be used.

Q. You are referring to its use for light and lubrication?

A. Yes, sir.

Q. These are the two main purposes for which it is now used. Now, suppose you could use it as economically as coal or other fuel, would that be important in this country?

A. It would be of the utmost importance.

Q. When we get the art of using petroleum as it is now used in Russia and Turkey, for instance, where they run ships across the Caspian Sea and where they run trains entirely with petroleum for fuel, then it will be useful to this country, will it not?

A. Yes, sir; very.

Q. Then it is to be hoped that we can find some process by which it can be made available?

A. I expect that we can use petroleum for fuel in this country, and also use the waste products of its refinement in a great variety of chemical industries.

Q. Who discovered the fact that we have great quantities of petroleum?

A. When we consider the United States at large, we may consider the discovery due to a great many persons. The great petroleum fields of California were discovered by some of the geological parties of the California survey. Some of the discoveries of the petroleum fields of Colorado were made by myself, and so on.

Q. What I want to get at is whether geologic research is useful in developing the use of petroleum.

A. Geologic research directly leads to the discovery of the petroleum fields, and the study of this petroleum in the laboratory of the Geological Survey leads to the discovery of methods by which crude petroleum may be refined.

Q. Have you discovered any fertilizing substances?

A. To some extent.

Q. What are they?

A. Phosphates; more in the Southern States than elsewhere. We have discovered pretty large deposits in Georgia, Florida, Alabama, and Mississippi.

Q. Have you discovered any nitrates in the West?

A. Yes, sir; in some limited quantities.

Q. Where have you discovered these nitrates?

A. Chiefly in the Green River country, the Snake River country, and in some of the mountains of Utah.

Q. In the mountains or plains?

A. In the mountains and bad lands.

Q. Suppose there was a great supply of nitrates in the plains of the West, would you consider that was a valuable acquisition and source of wealth to the country?

A. I would.

Q. So you have felt encouraged in your geologic researches in the development which you have made in soda, borax, petroleum, and nitrates?

A. Yes, sir; in all of this except perhaps the nitrates. The discoveries in that direction have been meager.

Q. How about deposits of sulphur?

A. Very large deposits of sulphur have been discovered. Some of them by myself personally.

Q. Saltpeter and sulphur are the essential requisites for the manufacture of gunpowder; that makes us independent on that score?

A. Yes, sir.

Q. Is it regarded by you as a matter of national importance that the nation should be able to manufacture its gunpowder at home?

A. It is self-evident.

Q. I am merely directing attention to it. How about the gold and silver?

A. In relation to gold and silver I am not sure yet that any kind of investigations carried on by the Geological Survey have led to the discovery of gold and silver. In coal, iron, copper, petroleum, soda, and many other substances investigations of the Geological Survey are steadily working out practical results, but I do not feel assured that such practical results arise from our investigations relating to gold and silver, and yet we are discovering many facts which perhaps will eventually lead to practical economic results.

Q. I notice the attention of the Senate has been recently called to some sharp necessity for preserving the forests at the headwaters of the Missouri, and it is thought one of the reasons why that proposition has been brought forward (in fact, a bill has been brought forward by Senator Edmunds) is that the preservation of the forests is necessary to prevent the great inflow of water from the melting snows of the different ranges of mountains there. Do you think it would be important, in connection with the proposition of preventing the rapid flow of the waters into these streams, to extend the topography of that country so as to know how far the forests affect this question?

A. As the topography extends over the country it maps that timber.

Q. One other suggestion I wish to call your attention to, because I saw an allusion to it in a former paper of yours. You speak of the possibility of relieving the Lower Mississippi of its surplus water, by diverting the water after the snowfall from the Upper Missouri and other tributaries of that country. Do you think there is likely to be a practical outcome of that idea?

A. Senator, you touch me on a question in which I am very deeply interested. My judgment is that the only practical way of relieving the valley of the Mississippi, from Cairo to its mouth, of its flood is to take out the waters of the upper streams and use them in irrigation.

Q. Now, have you inquired into the topography of the upper country, the waters of the Missouri, for instance; have you a sufficient acquaintance with the general lay of the country to influence you to believe that such a scheme is practicable as an engineering project?

A. I have no doubt of it. I can now show in a general way where all of this water can be taken and utilized in irrigation, and to a large extent I can show to what particular lands they must be taken; and if we extend the topographic survey over that region as it has begun, we shall be able to show exactly where the water is to be taken out of the channels of the streams and spread over the ground in irrigation.

Q. Instead of the water flowing out of the Gulf, your view is that it can be, by some practical engineering process, diverted and made to make crops?

A. For every acre redeemed from the overflow in the South two acres on the great plains can be made fertile.

Q. If this proposition is a correct one, then it occurs to me, and I will ask you if you concur in it, that taking the topography of that part of the United States by very exact methods would be a work of great public benefit not merely to those Territories in the way of increasing the value of the lands, but also of the lower part of the Mississippi river to prevent overflows?

A. I most fully concur.

Q. You are willing to announce it to the world as your opinion as a geologist and scientist that there is a practicable way of diverting these waters without detriment to any other part of the country, and to aid the irrigation of the lands there, at the same time relieving the burdens of the Lower Mississippi.

A. I am thoroughly convinced of it; I have been studying the question for about fifteen years.

By the CHAIRMAN:

Q. Have you made any estimate of the probable cost of such diversion of the waters of the Upper Missouri?

A. The waters of each of the small tributaries must be diverted in detail. Each little stream must be taken out, because, to take out a great river implies great hydraulic works. The sources must be reached. The small streams must be taken out and the cost will be reduced thereby very greatly. In relation to the cost, it must be said that it cannot be very definitely fixed without first preparing a plan necessary for the works therefor. But there is another method for obtaining an approximate cost. There has been much experience in this country in irrigation, and irrigation works of great magnitude have been constructed in California, Utah, and Colorado. The cost of such irrigation works is pretty well known, and their cost is usually reckoned in relation to the amount of country irrigated; that is, it is said that it costs so much, whatever that amount may be, for the irrigation of land per acre.

Now, in Utah, experience has shown that in the irrigation of 375,000 acres the cost of the hydraulic works therefor has averaged about $6 per acre, but varying from $1.50 to about $11 per acre. In California, where irrigating works have been established on a still greater scale, the cost per acre is somewhat less.

By Mr. MORGAN:

Q. Have you ever examined those dams built across the Upper Mississippi for the purpose of making reservoirs?

A. No, sir; not in detail.

Q. I suppose the Engineer's reports show the cost?

A. Doubtless.

Q. That would furnish a practical idea of the expense of damming?

A. It would furnish some valuable data relating to the construction of irrigating works. The greatest engineering problems in America are the protection of the flood plain of the Lower Mississippi from overflow and the redemption of the great plains from their desert condition, and the two problems are practically one. But there is another problem of very great interest which the Geological Survey is attacking. I have already been questioned in relation to the geological survey under Professor Shaler, which is denominated the Division of Atlantic Coast Geology. The survey, as it has been developed up to the present time, exhibits the fact that an area about as large as that of the State of Pennsylvania is now unutilized coast marsh, which can be redeemed by proper drainage. There can then be added to the agricultural lands of the United States all that large area of swamp lands, and the lands thus redeemed from tide water will have a fertility which is inexhaustible.

Mr. HERBERT. You have spoken, in reply to Senator Morgan, of the usefulness of the work under you, which, of course, is not denied. I think nobody denies the usefulness of geological investigations; but have not these discoveries of which you have spoken been made by parties in the field, aided by the work in the laboratories here?

A. Yes, sir.

Q. And all this topographic work, making maps, and book making, so far as that is concerned, has simply been to illustrate and locate the discoveries which have been made by the parties in the field, so that, if the purpose of the Geological Survey be economic, and you are looking simply at economic results, a thorough geological reconnaissance connected with the necessary work in the laboratories would be sufficient or that purpose?

A. I do not see that that conclusion can be reached. I think not.

Q. Why, not? Perhaps I am wrong, but tell me why?

Major **Powell**. Why a geological reconnaissance is not as valuable as the survey we are now executing?

Mr. **Herbert**. Perhaps I did not use the right word, but I mean such investigations as your parties have made, will they be sufficient, aided as they are here in the laboratory, without map making?

A. No, sir.

Q. Why?

A. We could not discover without maps what we discover with them.

Q. Why could you not?

A. You ask me a technical question, and I must be pardoned if I use technical language in making reply.

Mr. **Herbert**. Use as plain language as you can.

A. In the first place, the facts discovered in the process of investigation by the assistants of the Survey cannot be conveyed to the public without maps. It is the most thorough and economic method of publishing results, and it publishes the results not only to experts but to the body of the people at large. You ask me why. In order to make this clear a little explanation is necessary. The crust of the earth, or that portion which can be studied by the geologist, is composed of geologic formations, as they are technically termed—that is, great sheets of rock. These sheets vary in thickness; one formation is thicker than another; the same formation is thicker in some places than in others. And they also vary in mineral constitution. Some sheets are composed of certain minerals, others of different minerals, and so on. In a general way these formations have been spread over the surface of the earth by a variety of agencies. After having been thus spread over the surface of the earth they have been subject to distortion in various ways and have been more or less broken up, and portions have been destroyed—that is, taken away to form other formations in other districts of the country. This distortion is of a double nature: First, the formations have been fractured in vertical directions and displaced; one portion of the formation may be lifted and another portion depressed, so that the formations are not continuous, but different portions lie at different altitudes. Again, they have been flexed, contorted, and bent in many ways, so that a geologic formation is not usually a plain sheet of rock, but a sheet which is broken, displaced, and tipped at diverse angles in divers regions. Now, geologic deposits of value, the ores and minerals that are used for commercial purposes, sometimes belong to particular formations. It is eminently so with coal; it is also true with regard to other valuable minerals. In order, therefore, to discover where the coal is to be found in some particular formation the sheet or stratum in which it is found must be traced. Because of the irregularities in its form it will in some districts appear at the surface, in others it will be found deeply underlying the surface, and in some districts the formation may be found to have been carried away by atmospheric degradation. Now, the irregularities of such formations can only be shown by the use of a good geologic map, together with a series of geologic sections which serve to explain the map.

Q. I understand perfectly well that he must have a map in order to show and understand himself the scientific relations of these various strata one to another, but must he also follow that up in order to show that there is coal in this region or iron in another region?

A. Yes, sir.

Q. In other words in order to follow the croppings of coal from place to place after discovering it he must make a map?

A. Yes, sir.

Q. But for the original discovery of coal it is not necessary to have a map; map-making comes afterwards?

A. Yes, the map is necessary for the original discovery of the coal for most regions of the earth. Since the geological formation in which coal may be found is broken and distorted, as I have explained, in order to discover where this formation is underground it becomes necessary to plot the outcroppings of that formation upon an accurate map and to obtain the dips and strikes, and also to obtain the measurement of superincumbent formations, *i. e.*, their thickness, their dips and their strikes, that we may be able to say where the formation which holds the coal may be found beneath the surface. The determination of the position beneath the ground of a geological formation which is covered by other formations which appear at the surface is an induction resting upon thousands and thousands of facts which have to be plotted upon accurate maps before the relations and teachings of these facts may be known. The map is therefore necessary to the geologist as part of his means of investigation. It is necessary primarily as an agency of discovery and after the discovery is made it becomes necessary in order to set forth the facts of the discovery..

I have indicated but one field of research in which the maps themselves are necessary; first, for the research itself, and, second, that the results of the research may be communicated to the public. But there are many other lines of research in which this same fact holds true. Throughout geologic surveys everywhere maps are necessary for sound, thorough work, and everywhere the same maps are necessary to publish the results of investigation to the world.

Mr. Chairman, may I say just a word in relation to the practical economic results which flow from scientific research? There are many investigations that may not at first seem to lead to economic results, but which ultimately and indirectly are of importance even for economic purposes. The scientific man, especially the geologist, for reasons which I have heretofore set forth, has to do with a vast complexity of problems. To select a part of these problems and work upon them may not lead to substantial results when other problems are neglected that have relation to the first. The whole body of research in geology has a very important practical value, because geologic investigation reveals the wealth buried beneath the surface of the earth. Sound geologic conclusions cannot be reached by following a few narrow lines of investigation, but all such lines of research must be followed that each may shed light upon the other. Unless this principle is fully recognized, a geologic survey might lead to conclusions of no value to the people at large, or conclusions might be reached so erroneous as to be misleading. It, therefore, often happens that in determining to inaugurate investigations in a particular line the one question asked is, "Are we likely thereby to discover facts that will shed light upon the general problems of geology?" feeling assured that ultimately all such research will be of economic value.

STATEMENT BY THE DIRECTOR OF THE GEOLOGICAL SURVEY.

Maj. J. W. Powell, Director of the Geological Survey, then appeared and continued his statement, as follows [reading]:

DEPARTMENT OF THE INTERIOR,
UNITED STATES GEOLOGICAL SURVEY,
Washington, D. C., December 31, 1885.

SIR: I have the honor to acknowledge the receipt of the following letter:

UNITED STATES SENATE,
Washington, D. C., December 28, 1885.

SIR: Will you please give us at your earliest convenience a statement showing, in detail and by item as well as the total, expenses incurred during the quarter ending September 30, 1885, by the eleven employés, who, according to your testimony, constitute the New England section of topography. You will, of course, include all expenses of transportation as well as of subsistence. The committee desires to see exactly how and for what the moneys are expended, and wish to be able to compare the system you have adopted with that in practice in the Coast Survey. If you have not all the accounts made out for the quarter ending September 30, 1885, you may substitute the quarter ending June 30, 1885.

Very truly yours,

W. B. ALLISON,
Chairman.

Maj. J. W. POWELL,
Director of Geological Survey.

In reply thereto I beg to make the following statement:

The topographic party in Massachusetts, to which reference is made, was composed of twenty-eight persons. The eleven persons mentioned in your letter were more permanent employés of the Survey. The seventeen were temporary laborers employed in the field. The twenty-eight persons were employed in parties of two or more in number, and vouchers were taken for the expenses of parties. For this reason it involved no more labor to set forth the expense of twenty-eight persons than it would of eleven. I have therefore made a schedule of all expenses for the topographic work in Massachusetts for the quarter ending September 30, 1885.

The money was disbursed by two officers, Mr. Bodfish and Mr. Karl; hence, two sets of schedules are made necessary. Mr. Bodfish paid subsistence in the field for 884¼ days, amounting to $1,064.75, and the average cost per day for subsistence was therefore $1.20. Mr. Karl paid subsistence for 1,122¾ days, amounting to $1,335.95; the average cost per day for subsistence of parties by him, therefore, would be $1.19. Mr. Karl also paid subsistence for persons traveling longer distances on railroads, involving hotel bills in various cities, for fifteen days, amounting to $43.60, making an average of $2.90 per day.

I am, with great respect, your obedient servant,

J. W. POWELL,
Director.

Hon. WM. B. ALLISON, *Chairman.*

Schedule of expenses incurred during the quarter ending September 30, 1885, *by employés of the U. S. Geological Survey in Massachusetts, under the direction of Sumner H. Bodfish, disbursing agent, and paid by the State of Massachusetts.*

Date.	Voucher.		Subsistence.		Transportation.		Property and miscellaneous.
	Vo.	Sub.	Time.	Amount.	Means.	Amount.	
1885.			*Days.*				
July 1	1	1	1½	$4 00			
1	1	2	½	70			
1	1	3	1½	4 00			
1	1	4	½	50			
2	1	5	2	2 50			
2	1	6	1½	4 00			
5	1	7	1½	2 00	Feed of public animals	$1 00	
7	1	8	1½	1 50			
7	1	9	½	50			
7	1	10	½	50			
7	1	11	1½	2 50			
7	1	12	½	75			
8	1	13	1½	3 00			
8	1	14	1½	1 50			
8	1	15	1½	2 50			
8	1	16	1½	1 30			
8	1	17	½	1 00			
8	1	18	½	1 00			
9	1	19	1½	1 40			
9	1	20	½	50			
9	1	21	½	60			
9	1	22	1½	2 00			
9	2	1	½	50			
9	2	2	1½	3 00			
9	2	3			Wagon	75	
10	2	4	1½	3 00			
10	2	5	½	50			
10	2	6	1½	2 00			
10	2	7	½	70			
10	2	8	1½	2 50			
10	2	9	½	75			
10	2	10	½	75			
11	2	11	16½	23 10			
11	2	11	1¼	2 45			
11	2	11					$5 00
11	2	11	12½	15 00			
11	2	11	21	12 00			
11	2	12			Feed of public animals	16 00	1 50
11	2	13	½	1 05			

Schedule of expenses incurred during the quarter ending September 30, 1885, *&c.*—Continued

Date.	Voucher.		Subsistence.		Transportation.		Property and miscellaneous.
	Vo.	Sub.	Time.	Amount.	Means.	Amount.	
1885.			*Days.*				
July 11	2	14			Wagon	$8 00	
11	2	15	1	$2 00			
11	2	16					$0 25
11	2	17	½	1 00			
11	2	18	1½	1 50			
11	2	19	1½	2 00			
11	2	20	½	1 50			
13	2	21	½	80			
13	2	22	6	4 35			
13	3	1	2½	5 00			
13	3	2	½	75			
14	3	3	1½	1 50			
14	3	4	½	70			
14	3	5	1½	1 00			
14	3	6	½	50			
15	3	7	1½	2 00			
15	3	8	½	50			
15	3	9	1½	1 50			
15	3	10	½	1 00			
15	3	11	½	50			
16	3	12	1½	1 50			
16	3	13	½	60			
16	3	14	1½	2 00			
16	3	15	½	1 00			
16	3	16	1½	2 60			
16	3	17	½	60			
17	3	18	1	1 00			
17	3	19	½	75			
17	3	20	1½	2 00			
17	3	21	½	75			
17	3	22	1½	3 00			
18	4	1	1½	2 00			
18	4	2	½	50			
18	4	3			Wagon	75	
18	4	4	½	1 00			
18	4	5	1½	2 50			
18	4	6	3	3 00	Feed of public animals	1 70	
20	4	7	3½	6 50			
20	4	8	½	50			
20	4	9	¾	1 20			
20	4	10					2 14
21	4	11	14	14 00			
21	4	12	2¼	2 25			
21	4	13	¾	75			
21	4	14	1½	1 50			
21	4	15	½	50			
21	4	16			Wagon	50	
22	4	17	1½	1 50			
22	4	18	½	50			
22	4	19			Wagon	1 25	
22	4	20	2¼	2 25			
22	4	21	¾	75			
23	4	22	1½	1 60			
24	5	1	3½	6 00			
24	5	2	½	50			
24	5	3	2½	3 00			
24	5	4	¾	75	Feed of public animal	50	
25	5	5					2 00
25	5	6	½	1 00			
25	5	7	1½	1 50			
25	5	8	½	50			
25	5	9	1½	1 50			
27	5	10			Shoeing public animal	1 00	
27	5	11			Wagon	3 50	
27	5	12	½	50			
27	5	13	½	1 00			
28	5	14	1½	1 50			
28	5	15	½	70			
29	5	16	1½	1 50			
29	5	17	½	70			
28	5	18	½	50			
28	5	19	5½	7 50			
28	5	20	½	50			
28	5	21	1½	1 50			
28	5	22					2 62
29	6	1	3	5 00	Feed of public animals	1 00	
29	6	2	2	2 00			
29	6	3	1½	1 50			
29	6	4			Wagon	50	
30	6	5	1½	1 50			

Schedule of expenses incurred during the quarter ending September 30, 1885, *&c.*—Continued.

Date.	Voucher.		Subsistence.		Transportation.		Property and miscellaneous.
	Vo.	Sub.	Time.	Amount.	Means.	Amount.	
1885.			*Days.*				
July 30	6	6	½	$0 70			
30	6	7	½	70			
30	6	8					$0 20
30	6	9					80
30	6	10	1½	1 50			
30	6	11	½	2 00			
30	6	12	½	70			
30	6	13	1½	1 50			
30	6	14	2¼	2 25	Feed of public animals	$1 00	
30	6	15	1	75	do	50	4 75
31	6	16	2¼	4 00	do	1 00	
31	6	17	½	60			
31	6	18	1½	1 50			
31	6	19	1½	2 00			
31	6	20	1	2 00			
31	6	21	½	70			
Aug. 1	7		26¼	20 00			
1	7		28¼	37 66			
1	7		26¼	13 50			
1	7		3½	4 67	Feed of public animals	22 25	4 50
Sept. 23	8						
July 1	8				Railroad	60	
1	8				do	40	
2	8				do	30	
2	8				do	1 00	
2	8		1½	75			
4	8		1½	4 00			
4	8		¼	25			
5	8		½	30	Railroad		
6	8				do	50	
6	8				do	70	
6	8				do	70	
6	8				do	10	
6	8				do	1 74	
7	8				Wagon	2 00	
8	8				Railroad	46	
9	8				do	1 06	
9	8		¼	50			
9	8				Wagon	2 00	
9	8				Railroad	50	
9	8				do	46	
9	8				do	1 00	
10	8		¾	1 50			
10	8				Railroad	1 06	
10	8				do	60	
11	8				do	1 20	
11	8				do	60	
11	8				do	1 00	
13	8				do	30	
15	8				do	30	
16	8				do	30	
16	9				do	50	
17	9				do	60	
17	9				do	45	
18	9		¾	1 00	Feed of public animals	50	
18	9				Railroad	84	
18	9				do	10	
18	9				Wagon	1 00	
18	9		¼	50			
20	9				Railroad	45	
20	9				Shoeing public animals	80	
20	9		½	62			
21	9		¼	25			
22	9				Railroad	30	
22	9				do	30	
22	9		¾	1 50			
23	9		¼	50			
23	9				Feeding public animals	25	
24	9				Stage	1 00	
25	9				Railroad	1 04	
25	9				Stage	50	
27	9				do	50	
27	9				Railroad	60	
28	9				do	20	
29	9				do	30	
29	9				do	20	
29	9		¼	25	do	35	
29	9		¼	25			
30	9		¼	25			
30	9				Feed of public animals	50	

Schedule of expenses incurred during the quarter ending September 30, 1885, *&c.*—Continued.

Date.	Voucher.		Subsistence.		Transportation.		Property and miscellaneous.
	Vo.	Sub.	Time.	Amount.	Means.	Amount.	
1885.			*Days.*				
July 30	9	......	....	....	Stage	$1 80	....
30	9	......	....	....	Railroad	1 10	....
31	9	......	....	....	do	40	....
31	9	......	....	....	do	30	....
31	9	......	....	....	do	20	....
31	9	......	¾	$1 05	Feed of public animals	50	....
Aug. 1	10	1	1½	1 50	....	....	....
1	10	2	1½	1 50	....	....	....
1	10	3	½	25	....	....	....
1	10	4	½	70	....	....	....
1	10	5	½	70	....	....	....
5	10	6	½	80	....	....	....
5	10	7	1½	2 50	....	....	....
5	10	8	1½	1 00	....	....	....
5	10	9	½	35	....	....	....
6	10	10	½	50	....	....	....
6	10	11	1½	1 00	....	....	....
7	10	12	1½	2 50	....	....	....
7	10	13	½	50	....	....	....
7	10	14	1½	2 50	....	....	....
7	10	15	½	50	....	....	....
7	10	16	1½	2 50	....	....	....
7	10	17	1½	1 50	....	....	....
7	10	18	½	40	....	....	....
7	10	19	....	....	....	....	$4 33
8	10	20	½	25	....	....	....
8	10	21	1½	2 50	....	....	....
8	10	22	1½	2 50	....	....	....
8	11	1	½	75	....	....	....
8	11	2	½	50	....	....	....
8	11	3	1½	2 50	....	....	....
10	11	4	1¾	1 75	....	....	....
10	11	5	3½	8 25	....	....	....
10	11	6	½	60	....	....	....
10	11	7	½	1 00	....	....	....
11	11	8	1	2 00	....	....	....
11	11	9	½	50	....	....	....
11	11	10	1½	1 50	....	....	....
11	11	11	½	1 00	....	....	....
11	11	12	½	1 00	....	....	....
11	11	13	2	2 00	....	....	....
11	11	14	½	50	....	....	....
12	11	15	½	40	....	....	....
12	11	16	1½	1 50	....	....	....
12	11	17	1½	2 50	....	....	....
12	11	18	2	1 50	....	....	....
12	11	19	½	70	....	....	....
12	11	20	1½	3 00	....	....	....
12	11	21	....	....	Wagon	1 00	....
13	11	22	½	70	....	....	....
13	12	1	1½	1 50	....	....	....
13	12	2	½	50	....	....	....
13	12	3	2	3 50	....	....	....
13	12	4	1½	1 25	....	....	....
13	12	5	½	50	....	....	....
13	12	6	½	1 00	....	....	....
14	12	7	1	1 25	....	....	....
14	12	8	1½	3 00	....	....	....
14	12	9	½	80	....	....	....
14	12	10	1½	3 00	....	....	....
14	12	11	¾	1 50	....	....	....
15	12	12	1¾	3 00	....	....	....
15	12	13	1½	1 50	Wagon	1 00	....
15	12	14	½	1 50	....	....	....
15	12	15	1½	2 00	....	....	....
15	12	16	1	1 00	....	....	....
15	12	17	....	....	....	....	1 50
15	12	17	8½	4 50	....	....	....
15	12	17	40¾	38 32	....	....	....
15	12	17	2¾	3 67	....	....	....
15	12	17	....	....	Feed of public animals	10 00	....
15	12	18	8¾	4 50	....	....	1 50
15	12	18	17¼	23 00	Feed of public animals	8 75	....
17	12	19	½	50	....	....	....
17	12	20	2½	3 50	....	....	....
17	12	21	½	50	....	....	....
17	12	22	....	....	....	....	25
17	13	1	½	50	....	....	....
17	13	2	3	3 75	....	....	....
18	*13*	*3*	½	40	....	....	....

hedule of expenses incurred during the quarter ending September 30, 1885, *&c.*—Continued.

ate.	Voucher.		Subsistence.		Transportation.		Property and miscellaneous.
	Vo.	Sub.	Time.	Amount.	Means.	Amount.	
885.			*Days.*				
g. 18	13	4	1½	$1 50			
18	13	5	1½	4 00			
18	13	6					$10 00
18	13	7	1½	1 50			
18	13	8	½	50			
19	13	9	½	50			
19	13	10	½	60			
19	13	11	½	50			
19	13	12	1½	1 50			
19	13	13	½	50			
20	13	14	1½	1 50			
20	13	15	2	2 00			
20	13	16	½	50			
20	13	17	1½	2 00			
21	13	18	1½	2 50			
21	13	19	½	70			
21	13	20	1½	4 00			
21	13	21	1½	2 00			
21	13	22	½	50			
21	14	1	3	2 50			
22	14	2	½	50			
22	14	3	2	1 93			
22	14	4	½	70			
22	14	5	1½	1 50			
22	14	6	1	2 00			
22	14	7	1½	2 00			
24	14	8	3½	4 40			
24	14	9			Wagon	$0 55	
25	14	10	5	7 50			
25	14	11	2	1 75			
26	14	12	2	1 50			
26	14	13	½	50			
26	14	14	½	50			
26	14	15	2	3 00			
27	14	16	1½	2 00			
27	14	17	1½	1 60			
27	14	18	½	50			
28	14	19	1½	1 00			
28	14	20	½	75			
28	14	21	2	2 00			
28	14	22	1	1 00			
pt. 1	15				Railroad	1 00	
1	15				Wagon	1 00	
1	15				Railroad	1 00	
4	15				do	84	
4	15				do	30	
5	15				do	1 20	
5	15				do	15	
5	15				do	50	
5	15				Wagon	30	
5	15				Railroad	35	
5	15		¼	75			
6	15				Railroad	84	
6	15				do	20	
6	15				do	34	
7	15				do	30	
7	15				do	34	
8	15				do	20	
8	15				do	66	
8	15				do	60	
9	15		¼	40			
10	15		¼	25			
10	15				Feed of public animals	50	
10	15				Railroad	30	
10	15				do	2 80	
10	15				do	30	
10	15				do	60	
11	15				do	30	
11	15				do	2 20	
11	15				do	80	
11	15				do	30	
11	15				do	30	
11	15				Wagon	70	
12	15				Railroad	30	
12	15				Wagon	85	
13	15				Railroad	30	
13	15				do	81	
13	15				do	30	
13	15				Wagon	85	
13	15				Railroad	39	

***Schedule of expenses incurred during the quarter ending September 30, 1885, &c.*—Continued.**

Date.	Voucher.		Subsistence.		Transportation.		Property and miscellaneous.
	No.	Sub.	Time.	Amount.	Means.	Amount.	
1885.			*Days.*				
Sept. 14	15				Railroad	$1 05	
15	15				do	2 00	
15	15		¼	$0 65			
15	16				Railroad	2 50	
15	16				do	73	
16	16		½	75			
17	16				Railroad	20	
17	16				do	40	
17	16				do	75	
17	16				do	20	
18	16				do	2 00	
18	16		¼	65			
18	16				Wagon	50	
19	16		¼	25			
19	16				Railroad	14	
20	16				Wagon	1 00	
20	16		¼	30			
20	16				Wagon	1 00	
20	16		¼	25			
21	16				Railroad	84	
21	16				Railroad	84	
21	16		¼	50			
21	16				Railroad	12	
21	16				do	14	
21	16				do	50	
22	16				do	30	
22	16				do	14	
22	16				do	30	
22	16				do	2 00	
22	16		¼	65			
22	16				Wagon	25	
24	16				Railroad	30	
24	16				do	1 70	
24	16		¼	50			
26	16		¼	50			
27	16		½	60			
28	16		½	50			
28	16				Feed of public animals	50	
28	16				Railroad	60	
28	16				do	25	
29	16				do	15	
31	16				do	15	
24	17	1					$1 50
24	17	1	8¾	4 50			
24	17	1	21¼	25 34			
24	17	1	1	1 33			
24	17	1			Feed of public animals	9 50	
24	17	2	½	1 00			
24	17	3	1½	3 00			
26	17	4	2	4 00			
27	17	5	1½	2 00			
27	17	6	½	50			
26	17	7					50
28	17	8			Feed of public animals	1 50	
28	17	9	½	70			
28	17	10	1½	3 00			
28	17	11			Shoeing public animals	2 75	
29	17	12	½	1 60			
29	17	13	1½	1 50			
29	17	14	½	50			
29	17	15					50
29	17	16	1½	4 00			
31	17	17			Wagon	25	
31	17	17			Railroad	2 00	
Aug. 1	17	17			do	25	
1	17	17	¼	75			
1	17	17	¼	75			
1	17	17			Wagon	50	
1	17	17			Railroad	2 00	
2	17	17	¼	75			
2	17	17			Railroad	45	
3	17	17	½	1 00			
3	17	17			Railroad	15	
29	17	18					1 50
29	17	18	8¾	4 50			
29	17	18	19¼	22 67			
29	17	18	½	67			
29	17	18			Feed of public animals	9 00	
30	17	19			do	2 00	
30	17	20	2¼	3 00			

hedule of expenses incurred during the quarter ending September 30, 1885, *&c.*—Continued.

ate.	Voucher.		Subsistence.		Transportation.		Property and miscellaneous.
	No.	Sub.	Time.	Amount.	Means.	Amount.	
885.							
t. 2	17	21	½	$0 75			
2	17	22	2	2 50			
2	18	1					$10 55
2	18	2			Feed of public animals	$6 00	
3	18	3	½	70			
3	18	4	1½	2 00			
3	18	5	½	50			
4	18	6	1½	1 50			
4	18	7	½	50			
4	18	8	6	6 75			
4	18	9			Feed of public animals	4 00	
4	18	10	½	1 00			
4	18	11	1½	4 00			
5	18	12	1½	1 50			
8	18	13			Feed of public animals	1 75	
8	18	14	2	5 00			
8	18	15					6 50
9	18	16					1 50
9	18	16	8¾	4 50			
9	18	16	15¾	21 00			
9	18	16			Feed of public animals	2 00	
g. 10	19	1	¾	75			
10	19	1			Feed of public animals	1 00	
31	10	2	½	1 00			
pt. 1	19	3	7	10 50			
1	19	4					50
2	19	5					90
2	19	6	1½	2 00			
3	19	7	1¾	3 00			
4	19	8	1½	2 50			
4	19	9	½	1 00			
5	19	10	1½	1 50			
7	19	11	½	75			
7	19	12	3½	5 25			
8	19	13	1½	2 00			
8	19	14	½	1 00			
10	19	15	½	1 00			
10	19	16	3½	3 50			
10	19	17	½	1 00			
11	19	18	½	50			
11	19	19	1½	3 00			
11	19	20	½	1 00			
11	19	21	1½	3 00			
12	19	22	1½	3 00			
12	20	1	½	50			
12	20	2	1½	2 50			
12	20	3	½	80			
12	20	4					1 50
13	20	4	8¾	4 50			
12	20	4	24¾	28 66			
12	20	4	1½	2 00	Feed of public animals	8 50	
13	20	5			do	3 50	
13	20	6	3¼	8 38			
14	20	7	3½	7 00			
15	20	8	1½	3 00			
15	20	9			Railroad	65	
15	20	10					75
15	20	10	4½	2 25			
15	20	10	5	6 66			
15	20	10			Feed of public animals	2 75	
15	20	11	½	50			
15	20	12	3¾	5 62			
16	20	13	½	50			
16	20	14	1½	1 50			
16	20	15	1½	2 25			
17	20	16			Feed of public animals	1 75	15
17	20	16			Shoeing public animals	50	
17	20	17	1½	3 00			
17	20	18	½	50			
18	20	19	1½	1 00			
18	20	20	1½	1 50			
19	20	21	1½	1 50			
19	20	22	1½	3 00			
ng. 29	21	1	½	1 50			
31	21	2	1	1 25			
31	21	3	½	40			
pt. 1	21	4	1½	75			
2	21	5	2	2 00			
2	21	6	½	70			
4	21	7	½	60			

Schedule of expenses incurred during the quarter ending September 30, 1885, *&c.*—Continued.

Date.	Voucher.		Subsistence.		Transportation.		Property and miscellaneous.
	Vo.	Sub.	Time.	Amount.	Means.	Amount.	
1885.			*Days.*				
Sept. 5	21	8	1½	$1 50			
5	21	9	½	60			
7	21	10	½	60			
7	21	11	1	1 50			
8	21	12	½	50			
8	21	13	1½	1 50			
9	21	14	2	2 00			
10	21	15	3	3 00			
10	21	16	1½	1 50			
11	21	17	¼	25			
11	21	18	1½	1 00			
12	21	19	2	2 00			
15	21	20	4½	4 25			
16	21	21	½	50			
16	21	22	1½	2 00			
17	22	1	1½	2 00			
17	22	2	2	2 00			
17	22	3	1½	2 25			
18	22	4	¼	25			
18	22	5	1½	1 00			
19	22	6	½	50			
19	22	7	½	70			
19	22	8	1½	1 50			
19	22	9	½	70			
20	22	10	¾	1 25	Feed of public animals	$0 50	$19 80
21	22	11					
21	22	12	½	1 00			
21	22	13	½	1 00			
21	22	14			Wagon	1 50	
21	22	15	2½	3 50			
21	22	16	4	6 00			
22	22	17	2	3 00			
22	22	18	2	2 00			
22	22	19	½	50			
23	22	20					4 50
23	22	21	2¼	3 00			
23	22	22			Railroad	1 95	
23	23	1	8½ ½	12 68 67	Feed of public animals	9 75	
23	23	2	2	2 00			
23	23	3	½	50			
23	23	4	2	2 00			
23	23	5	½	50			
24	23	6	½	1 00			
24	23	7	1½	2 25			
24	23	8	2	1 50			
24	23	9	½	1 00			
24	23	10	½	50			
25	23	11	½	50			
25	23	12	2	2 00			
25	23	13	1½	2 25			
25	23	14	½	1 00			
26	23	15	½	1 00			
26	23	16	1½	1 50			
26	23	17	1½	1 25			
26	23	18	½	50			
28	23	19	3½	5 25			
28	23	20	3½	3 50			
28	23	21	½	1 00			
29	23	22	18½	22 23			
29	23	22	2	2 67	Feed of public animals	9 50	
Aug. 24	24				Railroad	50	
24	24				do	80	
24	24				Wagon	1 00	
24	24				Railroad	1 10	
26	24				do	1 64	
27	24				do	10	
27	24				do	14	
28	24				do	30	
28	24				do	40	
29	24				do	40	
29	24				do	50	
29	24				do	40	
Sept. 1	24				do	80	
2	24				Feed of public animals	50	
2	24				Railroad	20	
3	24		½	40			
3	24				Feed of public animals	40	
3	24				Railroad	1 12	
3	24				do	30	

Schedule of expenses incurred during the quarter ending September 30, 1885, *&c.*—Continued.

Date.	Voucher.		Subsistence.		Transportation.		Property and miscellaneous.
	Vo.	Sub.	Time.	Amount.	Means.	Amount.	
1885.			*Days.*				
Sept. 3	24				Railroad	$0 30	
4	24				do	70	
4	24				do	62	
4	24		½	$0 50			
5	24				Railroad	80	
7	24		¼	75			
14	24		½	1 50			
14	24				Feed of public animals	25	
15	24		½	50			
17	24		½	75			
17	24				Railroad	15	
18	24				do	30	
18	24				do	12	
18	24		¼	1 10			
17	24				Railroad	66	
19	24		¼	75			
19	24				Feed of public animals	25	
20	24				Railroad	15	
20	24				do	6	
20	24		¼	1 25			
21	24		½	60			
21	24				Railroad	1 25	
21	24				do	1 40	
21	24				do	20	
22	24				do	1 22	
24	24		½	75			
24	24				Feed of public animals	25	
25	24		¾	75			
25	24				Feed of public animals	25	
26	24		¾	75			
26	24				Feed of public animals	25	
Aug. 1	24				Railroad	1 00	
30	24				do	30	
Sept. 1	24				do	1 50	
2	24		8½	6 50			
5	24				Railroad	50	
6	24				do	30	
7	24				do	70	
10	24				do	70	
11	24				do	40	
12	24				do	80	
12	24				do	70	
12	24				do	80	
15	24				do	10	
15	24				do	85	
16	24				do	70	
18	24				do	1 00	
18	24				do	50	
18	24				do	80	
19	24				do	46	
19	24				do	10	
21	24				do	30	
21	24				do	20	
21	24				do	26	
22	24				do	80	
23	24				do	10	
25	24				do	20	
25	24				do	30	
26	24				do	56	
28	24				do	26	
28	24				do	1 10	
28	24				do	30	
26	24				do	50	
26	24				do	80	
29	24				do	1 42	
30	24				do	80	
15	25	1			Wagon	2 45	
21	25	2	8½	5 50			
22	25	3	1½	3 00			
28	25	4	16¼	16 25			
29	25	5	½	1 00			
29	25	6	1½	1 00			
29	25	7	¼	25			
29	25	8	2	3 30			
30	25	9	1½	1 50			
30	25	10	1¼	2 50			
30	25	11	12	18 00		}	$9 76
30	25	12	1½	3 00			
30	25	13	½	50			
			884½	1,064 75		287 82	10 75

Schedule of field expenses incurred during the quarter ending September 30, 1885, by employés of the U. S. Geological Survey in Massachusetts, under the direction of Sumner H. Bodfish, disbursing agent, and paid by the United States.

Date.	Voucher.		Subsistence.		Transportation.		Property and miscellaneous.
	Vo.	Sub.	Time.	Amount.	Means.	Amount.	
1885, July 27	1				Purchase of team and wagon	$375 00	

Schedule of expenses incurred during the quarter ending September 30, 1885, by employés of the U. S. Geological Survey in Massachusetts, under the direction of Anton Karl, special disbursing agent, and paid by the State of Massachusetts.

Date.	Voucher.		Subsistence.		Transportation.		Property and miscellaneous.
	Vo.	Sub.	Time.	Amount.	Means.	Amount.	
1885.			*Days.*				
July 6	1	1					$4 00
10	1	2					50
10	1	3					79
14	1	4			Wagon	$2 00	
14	1	5	2	$5 00			
15	1	6			Ferriage	25	
15	1	6			do	61	
16	1	7			Expressage	25	
16	8	1					3 75
17	8	2					2 35
18	2	1					2 50
20	1	8					60
20	1	9	76	108 57			
21	1	10			Wagon	41 50	
22	2	2					4 00
25	2	3					2 00
27	2	4					15
27	8	3					5 00
28	2	5					2 75
29	8	4					5 00
30	8	5			Wagon	44 00	
30	8	6	120	138 00			
30	8	7			Wagon	40 00	
30	8	8	1	3 00			
30	8	9	1	1 50			
30	8	10			Wagon	1 50	
Aug. 1	11	1	12	12 72			
1	11	1	5	4 00			
1	11	1	5¾	6 91			
1	15	1	23	23 00	Railroad	9 33	
1	6	1			Wagon	4 00	
3	13		½	1 00	Railroad	37 07	
3	13				Wagon	75	
3	13	1					30
3	13	2					25
3	13	2½					5 50
3	13	3					1 00
3	13	4					9 22
3	13	5					4 50
3	13	6					1 50
3	13	7	35¾	42 90			
3	13	7			Wagon	12 00	
3	13	8	19	12 25			
3	13	9					3 65
3	1	6	2½	6 25			
4	3	1			Wagon	2 50	
5	3	2					2 00
5	3	3	1½	1 75			
6	2	7	70	100 00			
9	14	1					1 50
13	6	2					1 50
13	6	3					4 00
13	6	4					1 75
19	14	2					45
21	6	5					2 23
27	14	3	3½	3 50			
28	14	4	2	2 00			

hedule of expenses incurred during the quarter ending September 30, 1885, *&c.*—Continued.

Date.	Voucher.		Subsistence.		Transportation.		Property and miscellaneous.
	Vo.	Sub.	Time.	Amount.	Means.	Amount.	
1885.			*Days.*				
ug. 28	14	5			Wagon	$0 65	$2 50
29	14	6	2	$3 00			
31	14	7			Railroad	70	
31	14	8			Wagon	20 00	
31	14	9					1 50
31	14	10	92½	111 00	Wagon	28 00	6 00
31	2	8					1 51
31	2	9					28
31	6	6	31	23 25			
31	6	7			Wagon	46 50	
31	6	8			Forage	21 00	
31	6	9	93	93 00			
31	6	10			Wagon	40 00	
31	6	11			do	32 50	
pt. 1	3	4			do	2 00	
3	9	1	½	1 00	Railroad	11 50	1 25
3	9	2					54 25
3	9				Wagon	75	
4	3	5					3 50
5	3	6					50
5	2	10			Wagon	25	1 29
5	2	11					21
9	7	1	27	27 00			
9	7	2			Forage	9 00	
9	3	7	30	30 00	Wagon	11 00	
9	3	8	71¼	71 25	Forage	18 37	
9	3	9			Wagon	45	25
10	7	3	1	75			
10	7	4			Wagon	2 50	
14	6	5					3 00
15	7	6			Forage	75	
15	7	7	5	4 30			
15	7	8			Forage	3 55	
15	7	9	15	11 25			
15	7	10			Wagon	22 50	
15	3	10					45
16	7	11					1 00
16	7	12					25
17	3						50
19	3	11					90
20	5	15	28½	28 50	Forage	4 50	
22	4	1			Wagon	1 50	
24	4	2	62½	83 24			
24	4	3			Wagon	2 50	
26	12	2	1	1 50			
28	5	1			Wagon	1 00	
28	5	2			do	4 50	
29	12	3	1	1 50			
30	5	16	23	23 00			
30	7	13	10	10 00			
30	7	14			Wagon	19 95	
30	7	15	5	5 00			
30	7	16			Forage	8 55	
30	7	17	15	15 00			
30	7	18			Wagon	40 00	
30	7	19	22	18 92	Forage	10 65	
30	7	20			Wagon	40 00	
30	7	21	20½	22 27			
30	7	22	23	33 40			
30	7	23			Forage	11 55	
30	7	24					4 50
30	12	4	91½	169 37			
30	12	5	19	12 35			
30	12	6	52½	63 75			
30	12	7			Wagon	52 00	
30	12	8					2 72
30	4	4					1 15
			1,122¾	1,335 95		664 43	160 25

Schedule of field expenses incurred during the quarter ending September 30, 1885, by employés of the U. S. Geological Survey in Massachusetts, under the direction of Anto Karl, disbursing agent, and paid by the United States.

Date.	Voucher.		Subsistence.		Transportation.		Property and miscellaneous.
	Vo.	Sub.	Time.	Amount.	Means.	Amount.	
1885.			*Days.*				
July 10	1	......	½	$3 00	Railroad	$10 95	....
10	1	......	....	....	Wagon	1 15	....
10	2	......	....	....	Railroad	6 23	....
10	2	......	½	1 25	Wagon	1 00	....
10	3	......	1½	4 50	do	1 50	....
14	5	......	....	....	Railroad	2 25	....
14	5	......	5	15 50	Wagon	5 50	....
Aug. 3	9	......	2	6 00	Railroad	1 50	....
3	9	......	....	....	Wagon	3 75	....
Sept. 7	15	......	....	....	do	107 00	....
21	18	......	....	....	Railroad	7 15	....
21	19	......	....	....	do	12 60	....
21	19	......	½	1 60	Wagon	1 00	....
30	23	......	....	....	do	56 50	....
30	25	......	....	....	Railroad	8 50	....
30	25	......	....	....	Wagon	1 00	....
30	26	......	....	....	....	....	$10 0
30	27	......	....	....	Railroad	7 90	....
30	27	......	4½	11 75	Wagon	4 75	....
			15	43 60		240 23	10 0

Schedule of salaries paid to employés of the U. S. Geological Survey in Massachusetts, during the quarter ending September 30, 1885, by the United States.

Paid by—	Paid to—	Compensation.		Amount paid.
		Yearly or monthly.	Amount.	
S. H. Bodfish	S. H. Bodfish	Per annum	$2,000 00	$500 00
Do	Lawrence Thompson	do	900 00	225 00
Do	R. H. Phillips	do	900 00	225 00
Do	H. L. Smyth	Per month	60 00	170 00
Do	W. J. Grambs	do	50 00	150 00
Do	E. B. Clark	do	50 00	150 00
Do	C. Arrick	do	50 00	150 00
Do	Van H. Manning, jr	do	50 00	150 00
Do	C. B. Hepburn	do	50 00	150 00
Do	M. T. Burns	do	55 00	110 00
Do	Charles C. Bassett	Per annum	840 00	141 00
Total	....	....	....	2,121 00
Anton Karl	Anton Karl	Per annum	2,000 00	331 50
Do	H. F. Walling	do	2,000 00	500 [illegible]
Do	Charles Dür	do	1,200 00	300 [illegible]
Do	Willard D. Johnson	do	1,600 00	400 [illegible]
Do	E. W. F. Natter	do	1,200 00	300 [illegible]
Do	Pink S. George	Per month	50 00	150 [illegible]
Do	Fessenden N. Chase	do	50 00	141 [illegible]
Do	George William Cook	do	50 00	126 [illegible]
Do	Frederic Mason	do	40 00	9 [illegible]
Do	J. H. Jennings	Per annum	840 00	210 [illegible]
Do	W. C. Brace	Per month	50 00	146 [illegible]
Do	F. S. Hunter	do	40 00	120 [illegible]
Do	R. Weilhart	do	40 00	120 [illegible]
Do	Robert D. Cummin	do	50 00	150 [illegible]
Do	William H. Lovell	do	45 00	185 [illegible]
Do	Charles H. Hewett	do	40 00	120 [illegible]
Do	Elmer Towle	do	40 00	9 [illegible]
Do	Charles C. Bassett	Per annum	840 00	68 [illegible]
Total	....	....	....	3,338 41
Grand total	....	....	....	5,460 41

Recapitulation of schedules of expenses incurred during the quarter ending September 30, 1885, *by employés of the U. S. Geological Survey in Massachusetts.*

Paid by—	Subsistence.			Transportation.	Property and miscellaneous.	Salaries.	Aggregate paid.
	Days.	Amounts.	Mean rates.				
State:							
Bodfish	884½	$1,065 95	$1 20	$287 32	$91 75	....	$1,445 02
Karl	1,122½	1,335 95	1 19	664 43	160 25	....	2,160 63
Total	2,007	2,401 80	1 20	951 75	252 00	....	3,605 65
United States:							
Bodfish	....	....	....	375 00	....	$2,121 60	2,496 60
Karl	15	43 60	2 90	240 23	10 00	3,338 81	3,632 64
Total	15	43 60	2 90	615 23	10 00	5,460 41	6,129 24
Grand total	2,025½	2,445 50	1 21	1,566 98	262 00	5,460 41	9,734 89

By the CHAIRMAN:

Q. You have condensed that statement all you could, major?

A. I could have condensed it more, but then it would not have given the full information for which you called.

Q. Does that table illustrate the expenditures of the several parties in the field fairly?

A. Yes.

Q. You think it is a fair example of what your different parties are doing in the field, then?

A. Yes; where those parties are subsisted by paying their bills in the field. In the far West and other portions of the country it is necessary to furnish them subsistence in kind; that is to say, we give them rations.

Q. But this is a fair example of the parties doing the interior work of the country?

A. Yes; wherever the assistants can board with the people.

Q. You were doing no geological work there?

A. Yes, sir; but you asked for designated persons.

By Mr. HERBERT:

Q. Were you doing any geological work in Massachusetts?

A. Yes, sir.

Q. Is that referred to here?

A. No, sir; but I have given a little more than you asked for; you asked for the expenses of 11 men; the accounts of the 11 men are mixed up with 17 others, and I have given the expenses of the whole number; that is, of 28 men.

Q. Are these 11 men of higher grade than the other 17 men that you have included?

A. Yes, sir.

Q. Then, would not the allowances of these 11 men have been more per capita than the allowance of the 28?

A. Not in the least. In the Geological Survey actual expenses are paid, as I have set forth. The dinner of a laborer at $40 a month costs the same as the dinner of a geologist, who receives $4,000 a year. For the same length of time, in the same district of country, the cost of subsistence must be the same for each man of a party, regardless of rank. The allowance of actual expenses for subsistence is not considered a part of a man's salary, and bears no relation to the rank of the person receiving the allowance.

By Mr. MORGAN:

Q. Why was that triangulation deflected at the foot of the Appalachian chain?

A. The site for the belt of geodetic figures was selected, because in the Appalachian Mountains elevated peaks are presented most favorable to such a triangulation. It runs, as you see, from the northeast to the southwest, following the trend of the mountains. On reaching the foot of the mountain system a belt of figures was run from that point westward to the Mississippi River, at Memphis. Now, there had previously been run a triangulation along the Mississippi River from Cairo to its mouth. This was a weak system of triangulation, intended not for geodetic purposes, but for map-making purposes solely, and in order that any error might be corrected, that the work might be checked, this main line of geodetic figures was run from the southern extremity of the Appalachians to Memphis. I believe this connecting line is yet unfinished. This main line along the Appalachian system is designed to connect with other weak lines along the coast.

Q. On what line is it proposed to connect the lake system of triangulation?

A. I do not know fully what the designs of the Coast Survey are; I think, though, that it is very apparent what ought to be done, and have no doubt that they intend to connect the belt of triangles extended by the lake survey from the foot of Lake Michigan southward with the transcontinental belt somewhere east of Saint Louis.

Q. But they follow the high country?

A. Yes, sir. This line [indicating] will doubtless be connected here [indicating]. The system of triangulation about the lakes and southward does not seem to be shown on this map; that is, the triangulation conducted by the Army engineers; if that were exhibited, the system would come out much more clearly.

Q. I notice some has been done in Middle Tennessee; that has been done upon high ground also, has it not?

A. That is upon high ground, too. Here [indicating] a line is started upon high ground and run out to the Ohio River.

By the CHAIRMAN:

Q. Was the survey of the Northwestern Lakes, so called, made by the Army?

A. Yes, sir.

Q. Is that a trigonometrical survey?

A. Yes.

Q. And the data of it is in the War Department?

A. Yes; it is accessible to every one.

By Mr. MORGAN:

Q. Is it also a geodetic survey?

A. Yes; when there is enough done to connect it with other work, it will be a part of the geodetic survey?

By the CHAIRMAN:

Q. No new survey would be required for the geodesy?

A. No, sir; it will constitute a part of the geodetic system.

Q. I will ask you again in reference to the Northwestern Lakes; were they surveyed on trigonometrical principles?

A. Yes.

Q. Now, then, taking the data thus acquired and applying the Clarke formula or value would be the method of connecting that with other geodetic surveys, would it not?

A. It would be a part of it.

Q. Would there be anything else required?

A. There would be much more required. The work of geodesy now is to discover the minor deformations of the earth. The general form and size of the earth are known with a fair approximation to accuracy; but geodesists are searching for a little greater accuracy in this respect. They are also searching for local inequalities or deformations. The earth is not a symmetric figure; the object is to discover the deformations by which it is rendered asymmetric. In order to do that, other instruments and methods are employed in addition to those mentioned by Mr. Colonna; gravimetric determinations are made with a pendulum; and most refined astronomic work now is also used; and very refined leveling is necessary. But further: This subject of geodesy, by which the form of the earth is learned, has come to be closely related to geology, which has to do with the constitution of the earth, or, at least, with the constitution of its crust, so that, to some extent, at least, and doubtless in the future to a greater extent, pendulum determinations have interest to the geologist, as well as to the geodesist. The surface of the earth, or rather the crust of the earth, seems to be in an isogravic condition. Suppose a circle were described on the surface of the earth, say 100 or 200 miles in diameter, which would represent the base of a cone, the apex of which should be at the center of the earth; and suppose that the base of this cone should be situated in some mountain region. Then let another similar cone be considered, the base of which is in some valley, or at the surface of the sea. Now, it seems probable that these cones would equal each other in weight, although the cone in the mountain region would be the higher. They would balance each other.

By Mr. Herbert:

Q. Do you mean to say that each of those cones ought to weigh the same?

A. Precisely. Now, that is simply a working hypothesis used by some geodesists and many geologists. Both classes of men are working together; they are trying to find whether it be true or not, and it matters not whether it be true or false, so that the facts themselves are discovered. This is certain, that the earth is not a symmetric figure, and the nature and extent of deformation is one of the subjects under investigation; and while searching for the characteristics of the deformation, they are also searching for the origin of the deformation. Thus it is that the problem of geodesy has come to be something more than a question of the magnitude and shape of the earth; it has also come to be a question of its constitution. The size, form, and constitution of the earth is a problem on which all lines of research in geodesy and geology converge.

By Mr. Morgan:

Q. Of course about two-thirds of the surface is covered by the ocean?

A. Yes, sir. The rock of the ocean areas seems to be heavier than the rock of the land areas, and there are geologic and geodetic reasons for this supposition. The most profound and ultimate problem of geodesy is the last and greatest problem of geology. Now, this problem is of such vast interest that every nation of Europe is engaged in its solution. Whatever disagreements may exist among European diplomats, whatever struggles for supremacy, whatever questions relating to the extent of territory may agitate the rulers, there is one great scientific question upon which they are agreed, the importance of solving the ultimate problem of geodesy and geology. In the presence of this question all international differences and jealousies disappear, and, for one purpose at least, Europe is but one state. In the interest of this one great scientific problem universal peace is declared.

The Commission took a recess until 2 o'clock p. m.

The Commission resumed its session at 2 o'clock p. m.

MUSEUM OF COMPARATIVE ZOOLOGY,
Cambridge, Mass., December 3, 1885.

Hon. H. A. HERBERT, M. C.:

MY DEAR SIR: Referring to your question that I should state what contributions the Coast Survey has made to zoology—

I would state that in 1849, soon after Prof. L. Agassiz came to this country he was invited by Professor Bache, the Superintendent of the Coast Survey, to join the United States Coast Survey schooner Bibb and to make some dredgings in the waters off Cape Cod. Again, in 1851, he went to Florida, at the request of the Superintendent of the Coast Survey, to examine the conditions of growth of the coral reefs of Florida, and to report upon the probable effect this would have upon the placing of light-houses along the line of the growing reef. He was subsequently interested in 1868 in the explorations regarding the physical conditions of the Gulf Stream, undertaken by the Coast Survey as early as 1845, which had been placed in charge of Mr. Pourtales in 1867, and who made two cruises in vessels of the Coast Survey to explore the depths of the sea in the channel between Key West and Florida. The results of Mr. Pourtales were of great scientific importance, and it was a great part owing to his publications and those of the Scandinavian naturalists interested in similar work that the English Government began the series of investigations of the physical and biological history of the seas, commenced with the Lightning and Porcupine and culminating in the well-known Challenger expedition, which sailed in 1873 and was gone three years, exploring the Atlantic, Pacific, and Southern Oceans, and making numerous collections and taking a great number of observations in the regions they passed over. The English Government is now publishing at great cost the results of this expedition, no less than fourteen 4° volumes having already been issued, and as many more will probably appear before the completion of the work.

In 1871 the Coast Survey sent out the steamer Hassler from Boston to San Francisco, and Professor Agassiz and Mr. Pourtales, with a scientific staff, were asked to accompany the vessel and undertake the solution of the very problems, many of which have been subsequently so admirably solved by the Challenger. The Hassler expedition was not successful in accomplishing what had been expected of it.

In 1877 Mr. Patterson, the Superintendent of the Coast Survey, invited me to take charge of the work formerly in charge of Mr. Pourtales. This I consented to do on certain conditions, and during two winters and one summer (1880) the Blake was placed at my disposal for the exploration of the bottom of the Gulf of Mexico, of the Caribbean, and of the Atlantic coast of the United States.

Very large collections were brought together to illustrate the geology and biology of these districts, and the results have been partly published, as explained to you in a former letter. The scientific results of the Blake have proved of the greatest interest to geologists and biologists, and I have no doubt the popular account of the trip, when it is issued, will prove the expedition to have been one of the most suggestive undertaken by the United States.

The Coast Survey has only published one memoir on the Blake expedition by Lieutenant-Commander C. D. Sigsbee, U. S. N., giving an account of the equipment of the Blake.

I think this covers the ground not touched upon in my former letter.

Yours, truly,

A. AGASSIZ.

HON. H. A. HERBERT TO PROFESSOR AGASSIZ.

WASHINGTON, D. C., *November* 27, 1885.

Prof. A. AGASSIZ:

DEAR SIR: Permit me to thank you for yours and Professor Newcomb's letters, both of which I shall consider very carefully. Availing myself of your kind offer to answer other questions, I beg to inquire whether in your opinion the work of the Geological Bureau could profitably be brought within proper bounds. To me it is very clear that Major Powell is transcending the rule you lay down, that Government ought not to do scientific work which can properly be accomplished by individual effort. For instance, I find that in 1867 Clarence King made an exhaustive examination of and published a large work about the Comstock lode; that in 1877 he was followed by J. A. Church, under Wheeler, with a similar book; that G. W. Becker, under Powell, wrote another exhaustive treatise on the same subject, complimenting Church by saying of him, "His memoir contains a number of hypotheses which would possess great scientific importance if sufficient evidence in their favor could be adduced." To me it seems that private individuals might do all this kind of work. In like manner, as I understand, Zerkel, in 1875, published a book on the collections of the explorations of the fortieth parallel. Major Powell seems to have considered that the Government had not published works enough about the Comstock lode, so in 1883 he had Elliot Lord to publish another book (451 pages), in which the same lode is treated from the standpoint of the historiographer—Government thus giving an interesting narrative of what had been accomplished by private enterprise, the wonderful results of an accidental discovery, &c. I would be obliged if you would let me know how and where to draw a line that would lop off some of this kind of work.

Again, is it necessary that a geological survey of the United States should go at all into paleontology? You will find, on pages 26 and 27 of the testimony taken before the Commission, Major Powell's letter. Please examine it, and let me know whether in your opinion everything he reports himself doing is essential. For myself, I am free to confess that if no part of all this can possibly be dispensed with, and if the people must be taxed for the maintenance of all that machinery to complete the geological survey now being prosecuted, the time has come when Congress ought to consider seriously whether it ought not to abolish the whole survey. Please tell me also whether you deem it imperative that the Government geologist should do topography? An answer at your very earliest convenience will greatly oblige,

Yours, very respectfully,

HILARY A. HERBERT.

PROFESSOR AGASSIZ TO HON. H. A HERBERT.

MUSEUM OF COMPARATIVE ZOOLOGY,
Cambridge, Mass., December 2, 1885.

HON. H. A. HERBERT, M. C.,
Washington:

MY DEAR SIR: In reply to yours of the 27th November, the points you make in regard to the economic work done by King and Powell on the Comstock lode are well taken, and I should in my former letter have referred to this subject. Private individuals have learned nothing from the works you refer to, and the scope of the investigation on mining industries of Comstock, Eureka, and Leadville, are all such as seem to me to fall within the limits of individual investigation. It will always be possible for specialists to write such memoirs, and if they are properly qualified, they will find no difficulty in having access to all the information obtained by Government officials of the Geological Survey. There is no more reason why the Government should publish a history of the mining enterprises of the country than that they should publish a history of manufacturing processes. All that is the province of private historians.

In fact, I do not see why men of science should ask more than other branches of knowledge, literature, fine arts, &c., beyond the limitations I had suggested of Government assistance. There is no end to that kind of interesting documents which the heads of bureaus could get printed at Government expense, and which very few individuals or societies would print, even had they the means at their command. The methods of publication adopted by the various bureaus, the mode of distribution, the size of the editions, are wasteful and extravagant. Editions running into the thousands and tens of thousands are often published, and there are not five hundred people or institutions whom they will do any good, or to whom such pure scientific publications can be of any service.

As regards the paleontology: That is just one of the things which private individuals and learned societies can do just as well as Government. They will do it cheaper. There are always in the different universities plenty of people who will be too thankful to do such work for the sake of doing it, and who will manage to get the gist of their results published by scientific societies to which they belong.

* * * * * * *

The material collected by the Blake and U. S. Coast Survey vessels at various times since 1867 to date has all been published by this museum at no expense to the Government. There have appeared thus far what represents 14 vols. 4°, with many plates, and 3 vols. 8°; and there still remain 1 vol. 8° and 2 4° to publish, the expense for which will not have been much less when completed than about $30,000. I am sure these publications would have cost Government, if done in usual bureau style, at least five or six times that amount. I inclose a marked list of the publications referring to Coast Survey material.*

I have a written proposition from a former Superintendent of the Coast Survey offering to publish all this as appendices of the Coast Survey reports at Government expense, all of which I respectfully declined to accept.

It is an impossible thing to make a good geological map of the country without having as a groundwork a good topographical map of the country. If the States are not willing to go to that expense, it seems plain that they do not wish the Government to go to that expense for them.

I have just received from the Coast Survey Office the memorandum of the remarks I made informally to you regarding the geodetic work of the Coast Survey, which I will condense and send to Survey Office, requesting them to send you a copy.

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* The following are the publications referring to Coast Survey material mentioned in the letter of Professor Agassiz:

BULLETIN.—Vol. I contains the following papers:

No. 6. Contributions to the FAUNA of the Gulf Stream at Great Depths. By L. F. de Pourtalès. pp. 18. Dec., 1867.
No. 7. Do. Second series. pp. 22. Dec. 10, 1868.
No. 9. Preliminary Report on the ECHINI and STARFISHES dredged in deep water between Cuba and the Florida Reef by L. F. de Pourtalès. Prepared by Alexander Agassiz. pp. 56. Octo., 1869.
No. 10. Preliminary Report on the OPHIURIDÆ and ASTROPHYTIDÆ dredged by L. F. de Pourtalès. Prepared by Theodore Lyman. pp. 46. Nov., 1869.
No. 11. List of the CRINOIDS obtained on the Coasts of Florida and Cuba in 1867, 1868, 1869. By L. F. de Pourtalès. pp. 4. November, 1869.
No. 12. List of HOLOTHURIDÆ dredged by L. F. de Pourtalès. pp. 3. November, 1869.
No. 13. Report upon the DEEP-SEA DREDGINGS during the Third Cruise of the U. S. Coast Survey Steamer "Bibb." By Louis Agassiz. pp. 24. November 16, 1869.

Vol. III contains the following:

No. 2. Preliminary Report on the CRUSTACEA dredged by L. F. de Pourtalès. Prepared by William Stimpson. Part I. pp. 52. Dec., 1870.
No. 4. Directions for DREDGING. Drawn up by L. F. de Pourtalès. pp. 4.
No. 5. Appendix to Preliminary Report on ECHINI. By Alexander Agassiz. pp. 3. April, 1871.

I am preparing a short note to go into the Nation in regard to all this Government business, which will represent, boiled down, my ideas as sent you in my letters and conversation at Survey Office.

Yours truly,

A. AGASSIZ.

On motion of Mr. Lowry, it was ordered that the oral testimony before the commission be now closed.

Adjourned.

Vol. III contains:

No. 1. BRACHIOPODS of the Straits of Florida. By W. H. Dall. pp. 45. 2 Plates. May, 1871.
No. 3. A letter concerning DEEP-SEA DREDGING addressed to Professor Peirce. By Louis Agassiz. pp. 5. December, 1871.
No. 7. Interim Report on the HYDROIDS collected by L. F. de Pourtalès. By George J. Allman. pp. 2. January, 1873.
No. 8. The ECHINI collected by the Hassler Expedition. By Alexander Agassiz. pp. 4. January, 1873.

Vol. V contains:

No. 1. Letter No. 1 to C. P. Patterson, Supt. U. S. Coast Survey, on the DREDGING OPERATIONS of the U. S. C. S. Str. "Blake." By A. Agassiz. pp. 9. April, 1878.
No. 6. Letter No. 2 to C. P. Patterson, Supt. U. S. Coast Survey, on the DREDGING OPERATIONS of the U. S. C. S. Str. "Blake." By A. Agassiz. With Preliminary Report on the Mollusca of the Expedition. By W. H. Dall. pp. 10. 2 Plates. July, 1878.
No. 7. OPHIURIDÆ and ASTROPHYTIDÆ of the "Challenger" Expedition. By T. Lyman. Part I. pp. 104. 10 Plates. July, 1878.
No. 8. Reports on the DREDGING OPERATIONS of the U. S. C. S. Str. "Blake." I. Description of SOUNDING MACHINE, Water-Bottle, and Detacher. By Lieut. Commander C. D. Sigsbee, U. S. N. pp. 11. 5 Plates. December, 1878.
No. 9. Reports on the DREDGING OPERATIONS of the U. S. C. S. Str. "Blake." II. ECHINI, by A. Agassiz. CORALS and CRINOIDS, by L. F. de Pourtalès. OPHIURANS, by T. Lyman. pp. 58. 10 Plates. December, 1878.
No. 10. Reports on the DREDGING OPERATIONS of the U. S. C. S. Str. "Blake." III. Report on HYDROIDA. By S. F. Clarke. pp. 14. 5 Plates. January, 1879.
No. 14. Letter No. 3 to C. P. Patterson, Supt. U. S. Coast Survey, on the DREDGING OPERATIONS of the U. S. C. S. Str. "Blake." By A. Agassiz. pp. 14. 2 Maps. June, 1879.

Vol. VI, Part I, contains:

No. 1. List of the DREDGING STATIONS occupied by the U. S. C. S. Steamers "Corwin," "Bibb," "Hassler," and "Blake," from 1867–1879. By Benjamin Peirce and Carlile P. Patterson, Superintendents of the U. S. Coast Survey. pp. 16. September, 1879.
No. 2. OPHIURIDÆ and ASTROPHYTIDÆ of the "Challenger" Expedition. By Theodore Lyman. Part II. pp. 67. 9 Plates. December, 1879.
No. 3. Reports on the Results of DREDGING under the Supervision of Alexander Agassiz, in the Gulf of Mexico, 1877–78, by the U. S. C. S. Str. "Blake." Lieut. Commander C. D. Sigsbee, U. S N., commanding. V. General Conclusions from a Preliminary Examination of the MOLLUSCA. By W. H. Dall. pp. 9. February, 1880.
No. 4. Report on the Results of DREDGING, by the U. S. C. S. Str. "Blake." VI. Report on the CORALS and ANTIPATHARIA. By L. F. de Pourtalès. pp. 26. 3 Plates. February, 1880.
No. 8. Letter No. 4 to C. P. Patterson, Supt. U. S. Coast Survey, on the DREDGING OPERATIONS of the U. S. C. S. Str. "Blake," Commander Bartlett, U. S. N., during the summer of 1880. By A. Agassiz. pp. 8. September, 1880.
No. 9. Reports on the Results of DREDGING by the U. S. C. S. Str. "Blake." VII. Description of a GRAVITATING TRAP for obtaining Specimens of Animal Life from intermedial ocean Depths. By Lieut. Commander C. D. Sigsbee, U. S. N. pp. 4. 1 Plate. September, 1880.

Vol. VIII contains :

No. 1. Reports on the Results of DREDGING by the U. S. C. S. Str. "Blake." VIII. Études préliminaires sur les Crustacés. Par A. MILNE-EDWARDS. 1e Partée. pp. 68. 2 Plates. Dec., 1880.

No. 2. Reports on the Results of DREDGING by the U. S. C. S. Str. "Blake." IX. Preliminary Reports on the ECHINI. By A. Agassiz. pp. 7. Dec., 1880.

No. 4. List of DREDGING STATIONS occupied during the year 1880 by the U. S. C. S. Str. "Blake." pp. 4. Feb'y, 1881.

No. 5. Reports on the Results of DREDGING by the U. S. C. S. Str. "Blake." X. Report on the CEPHALOPODS and on some additional Species dredged by the U. S. F. C. Str. "Fish Hawk, during the season of 1880. By A. E. Verrill. pp. 17. 8 Plates. March, 1881.

No. 7. Reports on the Results of DREDGING by the U. S. C. S. Str. "Blake." XI. Report on the ACALEPHÆ. By J. W. Fewkes. pp. 14. 4 Plates. March, 1881.

No. 11. Reports on the Results of DREDGING by the U. S. C. S. Str. "Blake." XII. Report on the SELACHIANS. By S. Garman. pp. 8. March, 1881.

No. 12. Reports on the Results of DREDGING by the U. S. C. S. Str. "Blake." XIII. Report on the PYCHNOGONIDA. By E. B. Wilson. pp. 18. 5 Plates. March, 1881.

Vol. IX contains:

No. 1. Reports on the Results of DREDGING by the U. S. C. S. Str. "Blake." XIV. Déscription sommaire des Espèces nouvelles d'Asteriee. Par E. Perrier. pp. 31. June, 1881.

No. 2. Reports on the Results of DREDGING by the U. S. C. S. Str. "Blake." XV. Preliminary reports on the MOLLUSCA. By W. H. Dall. pp. 112. December, 1881.

No. 3. Letter No. 5 to C. P. Patterson, Supt. U. S. Coast Survey, on the EXPLORATIONS in the vicinity of the Tortugas during March and April, 1881. By A. Agassiz. pp. 5. July, 1881.

No. 4. Report on the Results of DREDGING by the U. S. C. S. Steamer "Blake." XVI. Preliminary Report on the COMATULÆ. By P. H. Carpenter. pp. 20. 1 Plate. October, 1881.

No. 7. Explorations of the SURFACE FAUNA of the Gulf Stream under the Auspices of the U. S. Coast Survey. By A. Agassiz. I. Notes on ACALEPHS from the Tortugas, with a Description of New Genera and Species. By J. W. Fewkes. pp. 40. 7 Plates (3 double). April, 1882.

No. 8. On the ACALEPHÆ of the East Coast of New England. By J. W. Fewkes. pp. 20. 1 double Plate. April, 1882.

Vol. X contains:

No. 1. Reports on the Results of DREDGING by the U. S. C. S. Steamer "Blake." XVII. Report on the Crustacea. Part 1. DECAPODA. By S. I. Smith. pp. 108. 16 Plates. June, 1882.

No. 4. Reports on the Results of DREDGING by the U. S. C. S. Steamer "Blake." XVIII. The STALKED CRINOIDS of the Caribbean Sea. By P. H. Carpenter. pp. 16. December, 1882.

No. 5. Reports on the Results of DREDGING by the U. S. C. S. Steamer "Blake." XIX Report on the FISHES. [East Coast of the U. S.] By G. Brown Goode and Tarleton H. Bean. pp. 37. April, 1883.

No. 6. Reports on the Results of DREDGING by the U. S. C. S. Steamer "Blake." XX. Report on the OPHIUROIDEA. By Theodore Lyman. pp. 50. 8 Plates. May, 1883.

Vol. XI contains:

No. 1. Reports on the Results of DREDGING by the U. S. C. S. Steamer "Blake." XXI. Report on the ANTHOZOA and on some Additional Species dredged by the "Blake" in 1878–'79, and by the U. S. Fish Commission Steamer "Fish Hawk" in 1880–'82. By A. E. Verrill. pp. 72. 8 Plates. July, 1883.

No. 2. Reports on the Results of DREDGING in the U. S. C. S. Steamer "Blake." XXII. A Chapter in the History of the Gulf Stream. By Alexander Agassiz. pp. 5. May, 1883.

No. 3. Exploration of the SURFACE FAUNA of the Gulf Stream, under the Auspices of the U. S. Coast Survey. By Alexander Agassiz. IV. On a few MEDUSÆ from the Bermudas. By J. Walter Fewkes. pp. 10. 1 folding Plate. Aug., 1883.

No. 4. Report on the Results of DREDGING by the U. S. C. S. Steamer "Blake." XXIII. Report on the ISOPODA. By Oscar Harger. pp. 13. 4 Plates. September, 1883.

No. 5. Reports on the Results of DREDGING by the U. S. C. S. Str. "Blake." XXV. Supplementary Report on the Blake CEPHALOPODS. By A. E. Verrill. pp. 12. 3 Plates.

No. 7. Reports on the Results of DREDGING by the U. S. C. S. Str. "Blake." XXVI. VERZEICHNISS der von den United States Coast Survey Steamers "Hassler" and "Blake" von 1867 zu 1879. Gesammelten MYZOSTOMIDEN. Von Dr. L. V. Graff. pp. 9. November, 1883.

MEMOIRS.—Vol. III contains:

No. 7. Revision of the ECHINI. By Alexander Agassiz. pp. 796. 69 wood cuts. 94 Plates. 1872-'74. [Partly (½) Coast Survey.]

Vol. IV contains:

No. 8. The Zoölogical results of the Hassler Expedition:

I. ECHINI, CRINOIDS, and CORALS. By Alexander Agassiz and L. F. de Pourtalès pp. 54. With 15 Cuts and 10 Plates. February, 1874.

II. OPHIURIDÆ and ASTROPHYTIDÆ, including those dredged by the late Dr. Stimpson. By Theodore Lyman. pp. 34. With 5 Plates and 4 Cuts. February, 1875.

Vol. V contains:

No. 2. Report on the HYDROIDA collected during the Exploration of the Gulf Stream by L. F. de Pourtalès, Assist. U. S. Coast Survey. By George J. Allman, M.D., LL.D., F.R.S. pp. 66. With 34 Plates. November, 1877.

Vol. VII contains:

No. 1. Report on the FLORIDA REEFS. By Louis Agassiz. Accompanied by Illustrations of FLORIDA CORALS, from drawings by A. Sonrel, Burkhardt, A. Agassiz, and Roetter. With an Explanation of the Plates, by L. F. de Pourtalès. Published by permission of A. D. Bache and Carlile P. Patterson, Superintendents of the U. S. Coast Survey. pp. 61. 23 Plates. May, 1880.

Vol. III contains:

No. 2. Exploration of the SURFACE FAUNA of the Gulf Stream under the Auspices of the U. S. Coast Survey. By Alexander Agassiz. III. Part I. The PORPITIDÆ and VELELLIDÆ. By Alexander Agassiz. pp. 16. 12 Plates. July, 1883.

Vol. X contains:

No. 1. Reports on the results of DREDGING by the U. S. C. S. Steamer Blake. XXIV. Part I. Report on ECHINI. By Alexander Agassiz. pp. 126. 32 Plates. Sept., 1883.

In course of preparation: Reports on the Dredging Operations in charge of Alexander Agassiz, by the U. S. Coast Survey Steamer "Blake," for 1877, 1878, 1879, and 1880: H. B. Brady (Foraminifera), W. H. Dall (Mollusks of the Gulf of Mexico and the Caribbean Sea), G. B. Goode and T. H. Bean (East Coast Fishes and Fishes of the Gulf of Mexico and the Caribbean Sea), C. E. Hamlin (East Coast Mollusks), A. A. Hubrecht (Nemerteans), A. Milne-Edwards (Crustacea), J. Murray (Sea Bottoms), A. E. Verrill (Alcyonaria), and H. Théel (Holothuroidea).

WASHINGTON, D. C., *Saturday, January* 30, 1886.

The Joint Commission met pursuant to call of the chairman. All the members present.

The chairman laid before the Commission the following letter, received from Maj. John W. Powell, Director of the Geological Survey, in response to inquiries of the Joint Commission, which was ordered to be printed in the record:

LETTER OF PROFESSOR POWELL.

DEPARTMENT OF THE INTERIOR,
UNITED STATES GEOLOGICAL SURVEY,
Washington, D. C., January 25, 1886.

SIR: I have the honor to acknowledge the receipt of the following letter:

U. S. SENATE,
ROOM OF THE COMMITTEE ON APPROPRIATIONS,
January 6, 1886.

SIR: I am directed by the Hon. William B. Allison, chairman of the Joint Commission on the Government Surveys, to request that you will kindly furnish the Commission a statement respecting the twenty-four scientific assistants provided for the Geological Survey by the sundry civil appropriation act for the fiscal year 1885, giving the name of each of said assistants, his occupation or duty, where employed, amount paid for salary, and amount paid for board, the amount paid for board to include all hotel bills and meals paid for while traveling, whether paid in the traveling voucher or otherwise, and all other expenses of board or subsistence, the object being to ascertain how much in addition to salary has been paid each of these employés to defray expenses of living. It may be necessary to obtain this information from the vouchers themselves.

Also, a similar statement respecting the persons employed under, and paid out of, the lump appropriation of $386,000 for the Geological Survey for the fiscal year 1885, made by the above act, wherever a person has received compensation at $75 or over per month.

These statements are desired in tabular form, if practicable, and as soon as they can be conveniently furnished.

Very respectfully,

THOMAS P. CLEAVES,
Clerk to Joint Commission.

Maj. J. W. POWELL,
Director of the U. S. Geological Survey.

In reply to the above, I beg to submit the following statement and accompanying tables.

Subsistence is paid in several different ways, which need to be discriminated to obtain a satisfactory understanding of cost. Employés traveling to and from their fields of work purchase meals en route, and subsistence of this sort is relatively expensive. All field assistants in the conduct of their work have to travel more or less. When a camping party is not organized, the field assistant is subsisted at hotels or at private houses. He may spend several days at the same place or he may change his stopping-place daily. He frequently purchases his dinner at some place different from the hotel where he passes the night. If a camping party is organized, the members are subsisted on rations, which are prepared by a camp cook. Therefore the cost of subsistence is computed under three heads:

First. Single meals purchased en route.

Second. Board, including items of two or more meals, and usually including lodging also. These are hotel bills, or the equivalent charges of private houses. A "day's board" always includes a lodging and three meals.

Third. Rations. The computation here ordinarily includes only uncooked provisions (in the Quaternary Division there were a few purchases of cooked provisions).

In ascertaining the cost of subsistence when rations are furnished, the wages paid to the cook and the cost of transportation are not included. The cook is an extra hand for many other purposes; and it is impossible to discriminate the cost of his services as cook from the cost of his other services. In like manner, transportation is necessary for instruments and other camp equipage, and it is impossible to discriminate the cost of transportation of rations from the cost of other transportation.

The ration, like the other forms of subsistence, is not an emolument or accessory compensation for services. The regulations limit its amount, and the employé has no claim for any ration not actually consumed.

The expenses of subsistence are paid only when parties are traveling, and hence away from their customary homes.

A table has been prepared showing the amount of salary and the amount of subsistence of each kind allowed each of the 24 officers of the Survey whose salaries are enumerated in the sundry civil bill.

A second table has been prepared showing the amount of salary or wages paid and the amount of subsistence of each kind allowed to every one of the persons employed under the clause appropriating $386,000 in the same bill whose salary was $75 per month or more, $900 per year or more, or $3 per day or more, during any part of the year.

A third table has been prepared to exhibit the amount of salary or wages paid and subsistence of each kind allowed to every other employé of the Survey not included in Tables I and II, such salaries and subsistence having been paid from the appropriation contained in the sundry civil bill.

The three tables, therefore, exhibit the amount of salaries or wages paid, and the cost of subsistence furnished, of each kind, to every employé of the Geological Survey (except the office force, provided for in the legislative appropriation bill) during the fiscal year included in the interrogatories.

The information contained in the third table was not called for in the letter of the chairman, but was furnished for the following reasons:

First. It was necessary to examine all of the salary and subsistence vouchers taken during the fiscal year in order to extract therefrom the information called for.

Second. The field work of the Geological Survey is to a large extent executed by parties, and in each party there are one or two persons receiving salaries of $75 or more per month, and from two to five persons receiving salaries of a less amount, and it is customary for the chief of the party to pay for the meals or board of the entire party, and thus the bills of those receiving the lower wages are included in the same vouchers with those receiving the higher salaries.

Third. Rations are purchased for parties and are consumed by party messes, in which there is no discrimination as to rank or amount of salary paid.

For these reasons it involved but little additional labor to prepare the third table, and by so doing more satisfactory information is conveyed.

On examination of the third table it will be seen that certain persons were furnished subsistence who received no compensation as wages. Such persons performed volunteer services in pointing out town, county, and State lines, or in some cases that they might learn the use of instruments and methods of surveying.

The following is a recapitulation of the three tables thus described:

	Number of employés.	Amounts paid for services.	Subsistence.								
			Number of employés subsisted.	Meals en route.		Board.		Rations		Total.	
				Number.	Amount.	Days.	Amount.	Number.	Amount.	Days.	Amount.
I.—Permanent force	24	$67,477 50	19	1,238	$757 10	865⅓	$1,534 22	506	$197 34	1,784	$2,488 66
II.—Temporary force, receiving $75 per month or over	148	144,014 92	106	2,756	1,728 79	3,208⅓	4,983 04	6,904	2,481 52	11,031	9,193 35
III.—Temporary force, receiving less than $75 per month	352	69,068 56	256	3,703	1,536 43	5,640	6,923 81	14,294	5,259 59	21,168	13,719 83
Aggregate	524	280,560 98	381	7,697	4,022 32	9,714	13,441 07	21,704	7,938 45	33,983	25,401 84

Mean cost of meals en route	$0 52
Mean cost of board (per day)	1 38
Mean cost of rations (1 ration=1 day)	37

A fourth table has been prepared, derived chiefly from the foregoing, to exhibit the cost of subsistence *by divisions* in different portions of the United States.

The mean cost per ration in this table by divisions is obtained by dividing in every case the total expenditure by the total of rations; and the total of rations is obtained by summing the periods for which the employés of the division were subsisted in the field.

For comparative purposes there is added a column headed "Cost of ration at customary prices." These customary rates are obtained by ascertaining the prices from the purchase vouchers and combining these with the maximum quantities of the various articles included in the survey ration.

It will be observed that the cost of ration at the customary local prices is always somewhat greater than the actual cost, as shown by the accounts. Usually the consumption of a field party is somewhat within the limit assigned by the regulations. This is due to several causes. First, the ration of the regulation is made ample to avoid injustice that would otherwise arise in special cases; second, in unsettled countries game is frequently procured in large quantities; third, articles of food not included in the regulation ration are sometimes purchased at private cost; fourth, parties are sometimes entertained by hospitable citizens who are interested in their work; and fifth, in the unsettled portions of the United States it sometimes happens that the distances to be traversed by parties while away from bases of supplies are great; and economy in the cost of transportation is secured by dropping certain expensive, perishable, and bulky articles from the ration, and substituting other articles in lieu thereof, *e. g.*, fresh meat may be dropped and bacon substituted.

It should also be noted that in unsettled districts purchases for provisions are necessarily made in advance for trips covering several weeks; and when such a period falls within two fiscal years, the consumption of one fiscal year is partially provided for by the purchases in the other. In two cases of this nature approximate apportionments are made, so that no substantial error arises therefrom.

In the Division of Quaternary Geology the cost of ration is apparently excessive, being 56 cents. This is explained as follows: A small party in this division was subsisted a part of the time by being boarded, but part of the time excursions were made far away from human habitations, and under such circumstances cooked rations and canned rations were purchased for their use, but cooks were not employed.

It will be observed in examining the fourth table that subsistence in the form of rations has been furnished to parties traveling in the far West and in the Appalachian Mountains, and in all other districts sparsely settled, while in New England and New Jersey and other regions thickly settled, subsistence in the form of board has been furnished.

It should also be stated that rations have been purchased from the Commissary Department of the Army when this could be done advantageously; but to a large extent it is not economic to purchase rations for the employés of the Geological Survey in large quantities, as the additional cost through transportation would exceed the saving made through wholesale rates.

There are certain persons in the Geological Survey whose salaries are paid under the authority of the legislative appropriation bill, and who have necessarily traveled on Government business during the year under consideration. The subsistence furnished such persons is set forth in Table V, which has been added in order that this statement may show all of the subsistence furnished to every member of the Survey.

After the foregoing statement and accompanying tables had been prepared, the following telephonic message was received from the chairman of the Commission:

SENATE CORRIDOR, *January* 23, 1886.

To Prof. J. W. POWELL,
Director Geological Survey:

Please state, in your answer to inquiries made, if allowances for subsistence, in any form, to parties employed in Washington, have been made while employed here.

W. B. ALLISON.

The following is the reply thereto:

No person regularly employed in Washington has been furnished subsistence during the time so employed.

Prof. T. C. Chamberlin, in charge of the Quaternary Division of Geology, when he had his office in Beloit, Wis., was called to Washington for a conference with the Director, and his hotel bill while in Washington was paid. The same is true with regard to Mr. Raphael Pumpelly, in charge of the Archean Division of Geology, who was at work in New England; Mr. Arnold Hague, who was at work in a laboratory in New York City furnished by the American Museum; Mr. A. O'D. Taylor, who was also a member of the Archean Division; and Mr. George F. Becker, who has charge of the work in California and has his office in the Government building at San Francisco.

Professor Rockwood, of Princeton College; Professor Davis, of Harvard University; Professor White, of the University of West Virginia; and Professor Proctor, State geologist of Kentucky, visited Washington during the year, at the request of the Director, for conferences on methods of research, and their expenses while in Washington were paid.

The following is a schedule of all hotel bills paid in Washington during the fiscal year ending June 30, 1885:

***Hotel bills paid at Washington, D. C., for board and lodging for members of the United States Geological Survey from July* 1, 1884, *to June* 30, 1885.**

Persons.	Dates.	Hotel bills.		Hotel.
		Time.	Amount.	
Chamberlin, T. C	Aug. 27, 1884	Lodging	$1 00	Saint James.
Do	Aug. 28, 1884	2 meals	1 80	Do.
Do	Sept. 11, 1884	2 meals	90	
Do	Sept. 11, 12, 1884	Lodging	1 50	
Do	Sept. 12, 1884	1 meal	75	
Pumpelly, Raphael	Sept. 20, 1884	1 meal	1 25	
Do	Jan. 17, 18, 19, 1885	2 days	10 00	Wormley's.
Do	Apr. 22, 23, 24, 1885	3 days	15 00	Do.
Hague, Arnold	Oct. 28–30, 1884	2½ days	10 00	Do.
Rockwood, C. G	Nov. 21, 22, 1884	1¾ days	7 00	Ebbitt.
Davis, W. M	Nov. 21, 22, 1884	1¾ days	7 00	Do.
White, I. C	May 13, 1885	1 day	2 50	National.
Taylor, A. O'D	Mar. 19–21, 1885	3 days	7 50	Do.
Proctor, John R	June 28–30, 1885	2 days	9 00	Ebbitt.
Becker, George F	Apr. 10–13, 1885	3 days	12 00	Wormley's.
Do	Apr. 13–27, 1885	14 days	49 00	Metropolitan Club.
Do	May 3–13, 1885	10 days	24 00	Welcker's.
			160 20	

I beg to be indulged in the expression of the opinion that the exhibit made in the accompanying schedules demonstrates that the business of the Geological Survey has been transacted with all of the economy possible in an enterprise of the same magnitude even of a private character.

I am, with great respect, your obedient servant,

J. W. POWELL,
Director.

Hon. W. B. ALLISON,
Chairman, &c.

Amounts paid to employés of the United States Geological Survey for services and the cost
June

I.—PERMANENT FORCE.

	Name.	Employment.	Where employed.	Salary.		
				Rate.	Time.	Amount.
1	Brown, J. S	Geologist	District of Columbia	*$2, 000 00	1 y	$2, 000 00
2	Bodfish, S. H	Topographer	Massachusetts	*2, 000 00	1 y	2, 000 00
3	Becker, G. F	Geologist	California	*4, 000 00	1 y	4, 000 00
4	Chamberlin, T. C	....do	Wisconsin and Iowa	*3, 000 00	1 y	3, 000 00
5	Clarke, F. W	Chemist	D. C. and New Eng	*3, 000 00	1 y	3, 000 00
6	Curtis, J. S	Geologist	District of Columbia	*3, 000 00	1 y	3, 000 00
7	Emmons, S. F	do	Colorado	*4, 000 00	1 y	4, 000 00
8	Gannett, Henry	Geographer	D. C. and Mass	*2, 700 00	1 y	2, 700 00
9	Gilbert, G. K	Geologist	D. C., Appal. Mts., and N. Mex.	*4, 000 00	1 y	4, 000 00
10	Hague, Arnold	....do	Yellowstone Park	*4, 000 00	1 y	4, 000 00
11	Holmes, W. H	....do	District of Columbia	*2, 400 00	1 y	2, 400 00
12	Hayden, F. V	....do	Montana	*4, 000 00	1 y	4, 000 00
13	Hillebrand, W. F	Chemist	Colorado	*2, 000 00	1 y	2, 000 00
14	Irving, R. D	Geologist	Wis., Mich., and Minn.	*2, 700 00	11 m	2, 477 50
15	Karl, Anton	Topographer	Massachusetts	*2, 000 00	1 y	2, 000 00
16	Marsh, O. C	Paleontologist	Connecticut	*4, 000 00	1 y	4, 000 00
17	Renshawe, John H	Geographer	Yellowstone Park	*2, 500 00	1 y	2, 500 00
18	Shutt, George W	General assistant	Va., W. Va., and D. C	*3, 000 00	1 y	3, 000 00
19	Thompson, Gilbert	Geographer	Ga., Ala., Md., Va., W. Va., Ky., and Tenn.	*2, 500 00	1 y	2, 500 00
20	Thompson, A. H	....do	Ariz., N. Mex., Kans., Mo., and Tex.	*2, 500 00	1 y	2, 500 00
21	Ward, Lester F	Paleontologist	D. C. and Dak	*2, 000 00	1 y	2, 000 00
22	Walling, H. F	Topographer	D. C. and Mass	*2, 000 00	1 y	2, 000 00
23	Williams, A., jr	Geologist	District of Columbia	*2, 400 00	1 y	2, 400 00
24	Walcott, C. D	Paleontologist	D. C., Vt., Ariz., and Tex.	*2, 000 00	1 y	2, 000 00
	Aggregate					67, 477 50

II.—TEMPORARY FORCE.

[Receiving $75 or more per month.]

1	Ahern, J	Topog. assistant	California	*$600 00 *900 00	1 y	$894 31
2	Atkins, J. D	Topographer	District of Columbia	*1, 200 00	27 d	89 01
3	Blair, H. B	Asst. topographer	Tenn. and D. C	*600 00 *1, 000 00	1 y	993 51
4	Bien, Morris	Topographer	Virginia and D. C	*1, 400 00 *1, 600 00	1 y	1, 596 73
5	Brodhead, Mark	Clerk	District of Columbia	*900 00 *1, 400 00	1 y	1, 391 88
6	Barbour, E. H	Asst. paleontolog't	Connecticut	*1, 200 00	9 m	900 00
7	Baur, G	Collector	....do	†80 00 †85 00	9 m	735 00
8	Blodgett, James H	Editor	District of Columbia	*1, 800 00	11 m	1, 647 40
9	Burnett, Charles A	Clerk	....do	*1, 200 00	1 y	1, 200 00
10	Blake, J. H	Asst. paleontolog't	Massachusetts	*1, 800 00	1 y	1, 800 00
11	Barus, Carl	Asst. geologist	District of Columbia	*1, 500 00 *1, 800 00	1 y	1, 795 15
12	Christie, P. H	Topographer	Md., Va., W. Va., Ky., Tenn., N. C., S. C., Ga., Ala., D. C.	*1, 800 00	1 y	1, 800 00
13	Curtice, Cooper	Asst. paleontolog't	Tenn., N. Y., and D. C	*720 00 *900 00	1 y	897 08
14	Chatard, T. M	Asst. chemist	N. Y., N. C., and D. C	*1, 000 00 *1, 500 00	1 y	1, 491 80
15	Cromwell, B. L	Skilled laborer	District of Columbia	‡3 00	9 d	27 00
16	Chauvenet, W. M	Asst. geologist	Wis., Mich., & Minn	‡5 00	42 d	210 00
17	Cross, C. Whitman	....do	Colo. and D. C	*1, 500 00 *1, 600 00	1 y	1, 595 91
18	Davis, W. M	....do	Mass., N. Y., Wis., and Iowa.	‡5 00	17 d	85 00
19	Dougherty, W. G	Carpenter	Yellowstone Park	‡4 00	2 d	8 00
20	Diller, J. S	Asst. geologist	Colo., Cal., Oreg., N. M., and D. C.	*1, 600 00	1 y	1, 600 00

* Per annum. † Per month. ‡ Per day.

of subsistence of such employés while traveling and in the field, during the fiscal year ending 30, 1885.

I.—PERMANENT FORCE.

Subsistence.								
Meals en route.		Board.		Rations.		Total.		
Number.	Amount.	Days.	Amount.	Number.	Amount.	Days.	Amount.	
								1
371	$139 94	60	$67 12			183⅔	$207 06	2
95	67 55	80½	189 75			112⅙	257 30	3
130	71 17	68	145 78			111⅓	216 95	4
23	18 50	20½	44 50			28⅙	63 00	5
17	12 75	14¼	26 50			19 11/12	39 25	6
22	18 00	3½	9 00	46	$18 28	56⅚	45 28	7
78	63 90	15¾	41 75			41¾	105 65	8
73	44 65	28 5/12	56 45	39	22 92	91¾	124 02	9
44	33 75	6¾	24 50	153	55 08	174 5/12	118 33	10
								11
28	22 25	15½	51 50	35	16 16	59⅚	89 91	12
3	1 50	2	2 50			3	4 00	13
21	12 55	23	58 00	12	3 49	42	74 04	14
39	35 50	99¼	141 48			112¼	176 98	15
								16
44	36 75	15⅓	39 50	89	30 84	119	107 09	17
18	8 87	98⅙	142 92			104⅙	151 79	18
48	24 14	41	64 78	32	12 57	89	101 49	19
99	86 00	66⅓	126 15	100	38 00	199⅓	250 15	20
								21
20	9 18	168¼	237 16			174 11/12	246 34	22
								23
65	50 15	38¾	64 88			60 5/12	115 03	24
1,238	757 10	865 5/12	1,534 22	506	197 34	1,784 1/12	2,488 66	

II.—TEMPORARY FORCE.

[Receiving $75 or more per month.]

10	$6 75	27¾	$55 50	121	$37 92	152 1/12	$100 17	1
								2
11	4 40	45¾	45 98	84	33 27	133 5/12	83 65	3
6	3 75	8½	12 50	130	51 53	140½	67 78	4
								5
								6
								7
								8
								9
								10
1	45					⅓	45	11
48	25 50	73½	125 02	12	4 71	101½	155 23	12
22	12 90	85½	126 38			92⅚	139 28	13
31	19 75	39½	43 00			49⅚	62 75	14
								15
9	6 75			27	7 87	30	14 62	16
88	55 85	22	56 25	60	23 84	109⅓	135 04	17
5	2 85	15¾	26 00			17 5/12	28 35	8
				2	72	2	72	19
79	53 00	11½	16 43	142	43 27	179⅚	112 70	20

Amounts paid to employés of the United States Geological Survey for services and the

II.—TEMPORARY FORCE RECEIVING

	Name.	Employment.	Where employed.	Salary.		
				Rate.	Time.	Amount.
21	Dutton, C. E., Capt. U. S. A.[1]	Geologist	Cal., N. M., and D. C	....	1 y	....
22	Davis, A. P	Topographer	Ariz., N. M., and D. C	*$900 00 *1, 200 00	1 y	$1, 195 09
23	Douglas, E. M	....do	Texas and D. C	*1, 500 00 *1, 600 00	1 y	1, 598 36
24	Dunnington, A. F	....do	....do	*1, 000 00 *1, 200 00	1 y	1, 196 72
25	Davis, C. D	Asst. geologist	Yellowstone Park	*900 00 *1, 400 00	1 y	1, 391 88
26	Dall, W. H	Paleontologist	District of Columbia	*2, 000 00	284 d	1, 559 78
27	Daniells, W. W	Asst. geologist	Wis., Iowa, and Minn	‡5 00	25 d	125 00
28	Dür, Charles	Topographer	Col., Mass., and D. C.	*1, 200 00	1 y	1, 200 00
29	Eldridge, G. H	Asst. geologist	Colorado	*1, 600 00	358 d	1, 569 55
30	Eakins, L. G	....do	....do	*600 00 *900 00	1 y	895 12
31	Fennell, F. P	Stenographer	District of Columbia	‡3 00	70 d	210 00
32	Fontaine, W. M	Paleontologist	Virginia	*2, 000 00	182 d	996 24
33	Fitch, C. H	Topographer	Texas and D. C	*1, 200 00	337 d	1, 144 50
34	Fiset, Franz	Field assistant	Texas	†50 00 †75 00	334 d	650 00
35	Farnsworth, F. L	Packer	Arizona	†75 00	166 d	406 45
36	Fletcher, L. C	Asst. topographer	Md., Va., W. Va. and D. C.	*600 00 *900 00	1 y	895 12
37	Gooch, F. A	Chemist	Yellowstone Park and D. C.	*1, 500 00 *2, 000 00	1 y	1, 991 83
38	Garrett, L. M. (ensign U. S. N.).	Asst. topographer	Yellowstone Park	....	97 d	....
39	Gannett, S. S	Topographer	Tenn., Va., N. C., Ga., and D. C.	*900 00 *1, 400 00	1 y	1, 391 88
40	Griswold, W. T	....do	Md., Va., W. Va., and D. C.	*1, 200 00 *1, 600 00	1 y	1, 593 47
41	Gill, DeL. W	Pal. draughtsman.	District of Columbia.	*1, 000 00	320 d	877 80
42	Gentry, J. W	Asst. paleontolog't.	....do	*1, 200 00	1 y	1, 200 00
43	Geiger, H. R	Asst. geologist	Va., W. Va., Md., and D. C.	*1, 500 00	1 y	1, 500 00
44	Goode, R. U	Topographer	Mo., Kan., and D. C	‡4 25 *1, 600 00	359 d	1, 558 15
45	Howell, Charles W	Packer	Cal. and Nev	†75 00	188½ d	438 31
46	Hart, Joseph	....do	Yellowstone Park	†75 00	107 d	261 28
47	Hamblin, Joe	....do	Ariz. and N. Mex	†80 00	170 d	44[illegible] 89
48	Hays, J. W	Asst. topog. and topographer.	Ga., N. C., and D. C	*900 00 *1, 200 00	1 y	1, 195 09
49	Hall, C. W	Asst. geologist	Wisconsin and Iowa	‡4 50	62 d	279 00
50	Hallock, William	....do	Yellowstone Park and D. C.	*1, 200 00 *1, 400 00	1 y	1, 396 78
51	Hall, J. W	Geol. assistant	New York	‡5 00	36 d	180 00
52	Hill, F. J	Teamster	Dakota	†75 00	75 d	183 87
53	Hay, Robert	Geol. assistant	Kansas	‡4 00	14 d	56 00
54	Hawkins, R. R	Asst. Geologist	California	*1, 500 00	9 m	1, 125 00
55	Hayden, E. E. (ensign U. S. N.).[2]	Asst. paleontolog't.	District of Columbia.	....	1 y	....
56	Hoffman, J. D	Topographer	Va., D. C., and Mass	*1, 800 00	1 y	1, 800 00
57	Iddings, J. P	Asst. geologist	Yellowstone Park and D. C.	*1, 500 00	1 y	1, 500 00
58	Johnson, W. D	Topographer	Massachusetts	*1, 200 00 *1, 600 00	258 d	985 57
59	Johnson, L. C	Asst. geologist	Ala., Miss., and Fla	*1, 200 00	1 y	1, 200 00
60	Jones, C. C	Asst. photographer	District of Columbia.	*1, 000 00	359 d	983 73
61	Kübel, E	Mechanician	....do	*2, 100 00	4 m	700 00
62	King, Harry	Draughtsman	....do	*1, 600 00	11 m	1, 465 20
63	Klemroth, J. H	....do	....do	†100 00 ‡2 75	196 d	640 29
64	Knight, F. J	Field assistant	Dakota and D. C	†100 00 †150 00	348 d	1, 445 16
65	Kerr, M. B	Topographer	Cal., Nev., and D. C	*1, 500 00 *1, 600 00	1 y	1, 598 08
66	Lennon, J. J	Woodsman	Minn., Wis., and Mich	†100 00 ‡3 33⅓	81 d	266 66
67	Leffingwell, W. H	Topographer	Colorado	*1, 500 00	359 d	1, 475 50
68	Lindgren, W	Asst. geologist	California	*1, 200 00	7 m	701 10
69	McIntosh, L. H	Skilled laborer	District of Columbia.	‡3 00	20 d	60 00

* Per annum. † Per month. ‡ Per day.

cost of subsistence of such employés while traveling and in the field, &c.—Continued.

$75 OR MORE PER MONTH—Continued.

Subsistence.								
Meals en route.		Board.		Rations.		Total.		
Number.	Amount.	Days.	Amount.	Number.	Amount.	Days.	Amount.	
53	$40 50	6	$20 50	52	$19 66	75⅔	$80 66	21
25	19 00			221	83 98	229⅓	102 98	22
17	12 05	47¼	77 19	138	49 54	190 11/12	138 78	23
21	15 00	18⅓	36 25	121	43 62	146⅓	94 87	24
52	39 85	12 5/12	38 00	153	55 08	182¾	132 93	25
11	7 15	8⅓	25 75			12	32 90	26
								27
11	8 25			92	36 56	95⅔	44 81	28
47	34 35	33½	67 85	67	26 62	116⅙	128 82	29
55	31 85	9	25 00	76	30 19	103⅓	87 04	30
								31
								32
20	15 00	13½	29 25	124	44 82	144⅙	89 07	33
11	8 25			158	56 72	161⅔	64 97	34
				166	63 03	166	63 03	35
12	4 70	61¾	80 43	109	42 96	174¾	128 09	36
27	20 25	¾	1 50			9¾	21 75	37
		4	16 00	93	32 23	97	48 23	38
22	10 65	173¾	176 50	8	1 31	184 1/12	188 46	39
24	9 87	42¼	67 28	135	53 05	185¼	130 20	40
								41
								42
70	19 80	128¾	136 20			152 1/12	156 00	43
23	15 00	42¾	83 00	57	25 80	107 5/12	123 30	44
30	15 00	27¾	55 50	145	44 04	182¾	114 54	45
				107	38 52	107	38 52	46
				170	64 60	170	64 60	47
18	8 17	109	129 03	7	2 88	122	140 08	48
11	3 12	4¾	7 25			8 5/12	10 37	49
43	33 15	1¾	4 50	62	22 32	78 1/12	59 97	50
								51
15	7 50			70	24 12	75	31 62	52
								53
2	1 00	1¾	350 00			2 5/12	4 50	54
		2	5 75			2	5 75	55
8	6 30	122	154 64	45	16 96	169⅔	177 90	56
28	20 75	1	2 00	153	55 08	163⅓	77 83	57
2	1 50	117¼	240 65			117 11/12	242 15	58
18	9 00	222⅛	240 48			228⅛	249 48	59
								60
								61
								62
								63
48	27 45	3	9 00	68	23 44	87	59 89	64
173	117 05	37½	57 14	142	43 27	237⅙	217 46	65
5	2 40	1¾	3 50	73	21 24	76 5/12	27 14	66
55	37 50	31½	50 25	67	26 62	116⅚	114 37	67
18	11 75	35	51 50	171	31 81	212	95 06	68
								69

[1] Salaried by War Department.

[2] Salaried by Navy Department.

Amounts paid to employés of the United States Geological Survey for services and the

II.—TEMPORARY FORCE RECEIVING

	Name.	Employment.	Where employed.	Salary.		
				Rate.	Time.	Amount.
70	Maher, J. A	Asst. topographer.	Arizona and D. C	*$600 00 *900 00	1 y	$895 12
71	McKinney, R. C	do	Va. and D. C	*720 00 *900 00	1 y	897 08
72	Manners, E. C	Asst. chemist	District of Columbia.	*1, 500 00	335 d	1, 377 10
73	Melville, W. H	do	California	*1, 800 00	1 y	1, 800 00
74	Meyer, O	Field assistant	Connecticut	†80 00 †85 00	9 m	750 00
75	Marcou, J. B	Asst. geologist	D. C. and N. Y	*900 00 *1, 000 00	1 y	998 40
76	McGee, W J	Geologist	D. C., Va., and Wis	*1, 200 00 *1, 600 00	1 y	1, 593 47
77	Merriam, W. N	Asst. geologist	Wis. and D. C	*1, 200 00	1 y	1, 200 00
78	Middleton, J	Stenographer	District of Columbia.	*900 00	11 m	824 20
79	Mead, D. W	Field assistant	Wisconsin	‡4 00	171½ d.	686 00
80	Natter, E. W. F	Asst. topographer.	Massachusetts	†100 00	314 d	1, 035 48
81	Nell, Lewis	Topographer	Ga., Ala., Tenn., D. C.	*1, 600 00	354 d	1, 552 16
82	Noerr, Albert	Asst. topographer	District of Columbia.	*1, 000 00	1 y	1, 000 00
83	Noble, E. N	Stenographer	do	‡3 00	5 d	15 00
84	Newberry, J. S	Paleontologist	New York	*3, 600 00	72 d	997 71
85	Oley, Charles	Packer	Wis., Mich., & Minn.	‡2 50 ‡3 25	54½ d	142 25
86	Ohm, Hermann	Skilled laborer	District of Columbia	*900 00	348 d	858 44
87	Pomeroy, A. M[1]	Asst. topographer.	California	†75 00	42 d	101 59
88	Pearson, F. M	Topographer	Tenn. and D. C	*1, 500 00 *1, 600 00	1 y	1, 598 36
89	Pumpelly, R	Geologist	R. I. and Conn	*4, 000 00	350 d	3, 836 91
90	Peters, W. J	Asst. topographer.	Kansas	*900 00	341 d	841 92
91	Pritchett, H. S	Astronomer	Mo. and Kans	†150 00	5 m	750 00
92	Putnam, B. T	Asst. geologist	R. I. and Conn	*1, 500 00 *1, 800 00	10 m	1, 348 00
93	Peale, A. C	Geologist	Montana and D. C	*2, 000 00	1 y	2, 000 00
94	Rizer, H. C	Disbursing agent.	Ariz., Tex., Kans., and D. C.	*1, 800 00	1 y	1, 800 00
95	Ricksecker, E	Topographer	Cal. and D. C	*900 00 *1, 200 00	1 y	1, 194 08
96	Raborg, W. A	Asst. geologist	do	*800 00 *1, 200 00	1 y	1, 193 46
97	Ridgway, J. L	Draughtsman	District of Columbia	*900 00	10 m	748 40
98	Ritchie, J. P	Engineer	do	*1, 000 00	216 d	600 50
99	Rogers, A. M	Disbursing agent.	Colorado	*1, 500 00	1 y	1, 500 00
100	Riggs, R. B	Asst. chemist	District of Columbia	*900 00	3 m	225 00
101	Rockwood, C. J[2]	Geologist	N. J. and D. C			
102	Russell, I. C	Asst. geologist	Mich., D. C., N. C., and Va.	*1, 600 00	1 y	1, 600 00
103	Starek, E	Clerk	District of Columbia	‡3 00	13 d	39 00
104	Scholl, W. R	Draughtsman	do	‡2 75	19 d	52 25
105	Shaler, N. S	Geologist	N. J. and Mass	‡10 00	190 d	1, 900 00
106	Salisbury, R. D	Asst. geologist	Wis. and Iowa	‡5 00	82 d	410 00
107	Stone, G. H	do	Colorado and Maine.	‡5 00	99 d	495 00
108	Scott, Amos	Packer	Yellowstone Park	†75 00 †85 00	140 d	376 16
109	Stewart, E. D	Teamster and packer.	California	†60 00 †110 00	317 d	955 89
110	Shumway, W. A	Topographer	W. Va., Ky., and Dist. Columbia.	*1, 200 00 *1, 600 00	1 y	1, 593 47
111	Stuart, C. H	Packer	Yellowstone Park	†75 00	148 d	357 96
112	Schlosser, M	Field assistant	Connecticut	†80 00 †85 00	9 m	750 00
113	Stearns, R. E. C	Paleontologist	District of Columbia.	*2, 000 00	354 d	1, 940 29
114	Sayles, Ira	Geologist	W. Va., Tenn., and Dist. Columbia.	*2, 400 00	1 y	2, 400 00
115	Simpson, G. B	Field assistant	New York	‡5 00	30 d	150 00
116	Todd, J. E	Asst. geologist	Iowa, Dak., Minn., and Nebr.	‡4 00	92 d	368 00
117	Turner, H. W	do	California	*900 00 *1, 200 00	1 y	1, 195 09
118	Taylor, A. O'D	Spl. disbg. agent	Rhode Island and Connecticut.	‡6 00 *1, 800 00	287 d	1, 501 60
119	Thompson, L	Asst. topographer.	Massachusetts	†75 00	68 d	167 50

* Per annum. † Per month. ‡ Per day.

cost of subsistence of such employés while traveling and in the field, &c.—Continued.

$75 OR MORE PER MONTH—Continued.

Subsistence.								
Meals en route.		Board.		Rations.		Total.		
Number.	Amount.	Days.	Amount.	Number.	Amount.	Days.	Amount.	
24	$19 25			131	$49 78	139	$69 03	70
4	2 75	2¼	$2 50	127	50 16	130 7/12	55 41	71
								72
								73
								74
6	5 25	25	63 75			27	69 00	75
76	39 00	51	159 50			76⅓	198 50	76
14	7 70	15¾	45 87	73	21 24	93 5/12	74 81	77
5	2 75	1	1 50			2⅔	4 25	78
9	4 80	53¾	94 20			56¾	99 00	79
10	4 00	119½	149 52			122⅚	153 52	80
12	6 60	29½	52 75	85	33 40	118½	92 75	81
								82
								83
								84
4	1 25					1⅓	1 25	85
								86
				45	13 67	45	13 67	87
11	5 75	17½	18 22	125	49 12	146⅙	73 09	88
68	85 55	6¾	27 00			29 5/12	112 55	89
18	12 00	16½	23 37	74	32 56	96½	67 93	90
								91
8	7 80	38½	62 50			41⅙	70 30	92
40	33 79	30	90 25	35	16 16	78⅓	140 20	93
116	85 75	39¼	76 40	50	19 00	127 11/12	181 15	94
72	52 60	21	40 50	142	43 27	187	136 37	95
20	15 25					6⅔	15 25	96
								97
								98
								99
								100
1	70	1¾	7 00			2 1/12	7 70	101
18	11 45	49½	83 75	60	21 60	115½	116 80	102
								103
								104
9	5 00	42¾	87 00			45¾	92 00	105
40	17 35	35¾	63 12			49 1/12	80 47	106
85	43 20	41½	60 87			69⅚	104 07	107
				139	48 18	139	48 18	108
				142	43 29	142	43 29	109
17	5 20	58½	58 49	18	33 40	82⅙	97 09	110
				145	52 20	145	52 20	111
								112
								113
41	14 59	186½	169 34			200⅙	183 93	114
								115
7	2 30	3¾	6 00	54	30 34	60 1/12	38 64	116
39	19 10	62¼	105 00	286	53 20	361¼	177 30	117
8	1 35	6	13 50			7	14 85	118
76	36 65	34¾	44 07			60 1/12	80 72	119

[1] Worked 3 days gratuitously.
[2] Performed special work gratuitously.

Amounts paid to employés of the United States Geological Survey for services and the

II.—TEMPORARY FORCE RECEIVING

	Name.	Employment.	Where employed.	Salary.		
				Rate.	Time.	Amount.
120	Turner, H. L	Field assistant	Arizona	†$75 00	4 m	$300 00
121	Tweedy, F	Asst. topographer.	Yellowstone Park	*900 00	350 d	863 93
122	Titsworth, A. A	do	New Jersey	*100 00	11 d	35 48
123	Van Hoesen, H. I	Skilled laborer	California and D. C	*600 00 *900 00	231 d	561 81
124	Vermeule, C. C	Topographer	New Jersey	*1, 600 00	350 d	1, 534 77
125	Van Hise, C. R	Asst. geologist	Wis., Minn., and Iowa	‡4 00	161 d	644 00
126	Wright, G. M	do	Yellowstone Park and Dist. Col.	*900 00 *1, 200 00	1 y	1, 195 09
127	Wilson, H. M	Topographer	Arizona and D. C	*1, 500 00 *1, 600 00	1 y	1, 588 36
128	Willis, Bailey	Geologist	Dak., Tenn., N. C., and Dist. Col.	‡6 50 *2, 400 00	363 d	2, 385 84
129	Woodward, R. S	Astronomer	Mo., Kan., N. M., and Dist. Columbia.	*2, 000 00	334 d	1, 830 50
130	Ward, C. O	Stenographer	District of Columbia.	*600 00 *1, 000 00	142 d	382 06
131	White, B. N.[1]	Woodsman	Wis., Mich., and Minn	‡5 00	44¼ d	221 25
132	Weed, W. H	Asst. geologist	Yellowstone Park and Dist. Col.	*900 00 *1, 200 00	1 y	1, 195 09
133	Williams, G. H	do	New York and Wis	‡5 00	11 d	55 00
134	White, I. C	Geologist	W. Va., Penn., and Dist. Columbia.	*2, 000 00	350 d	1, 907 48
135	White, C. A	Paleontologist	California and D. C	*2, 400 00	1 y	2, 400 00
136	Whitfield, J. E	Asst. chemist	District of Columbia.	*1, 200 00	333 d	1, 095 63
137	Williston, S. W	Asst. paleontolog't	Connecticut	*1, 500 00	9 m	1, 125 00
138	Wakefield, G. F	Asst. topographer.	W. Va., Ky., and Dist. Columbia.	*720 00 *1, 000 00	10 m	827 27
139	Würdemann, H. V	Draughtsman	District of Columbia.	‡3 00	26 d	78 00
140	Wilson, C. C	Clerk	do	*1, 400 00	1 y	1, 400 00
141	Whiting, H. L., U. S. C. and Geod. Surv.[2]	Topographer	Massachusetts			
142	Wilkinson, E. (ensign U. S. N.)[3].	Field assistant	Colorado		95 d	
143	Warman, P. C	Clerk	District of Columbia.	*1, 200 00 *1, 400 00	1 y	1, 396 78
144	Watts, A	Field assistant	Arizona	†75 00	334 d	825 00
145	Wright, G. F	Asst. geologist	Ohio	‡5 00	79 d	395 00
146	Wallace, H. S	Asst. topographer.	Texas	*900 00	1 y	900 00
147	Williams, H. S	Assistant geologist	New York	†125 00 *1, 500 00	3 m	373 60
148	Yeates, C. M	Topographer	N. C., S. C., Ga., and D. C.	*1, 600 00	1 y	1, 600 00
	Aggregate					144, 014 92

[1] Subsisted, but not salaried on non-working days.

III.—TEMPORARY FORCE.

[Receiving less than $75 per month.]

1	Anderson, Rob't J	Rodman	California	†$40 00	52 d	$67 10
2	Adams, E. L	Topographic asst.	Ala., Ga., and Tenn	†50 00	71 d	116 12
3	Arnold, N. M	Teamster	Massachusetts			
4	Arrick, Clifford	Field assistant	do	†40 00	341 d	448 69
5	Allen, L. J	Cook	Tennessee	†30 00	212 d	208 41
6	Aspden, Walter	Packer	Yel. National Park	†50 00	10 d	16 67
7	Aplin, S. A	Asst. topographer	do	*720 00 *600 00	1 y	718 09
8	Adkins, A. W	Teamster	Texas	†30 00	165 d	102 09
9	Alexander, A	Barometric obs'r.	California	‡1 25	19 d	23 75
10	Anderson, George B.	Topographic asst.	California and D. C	†30 00 †35 00	135 d	122 88
11	Adams, Nathan H	Packer	Arizona	†55 00	195 d	349 52

* Per annum. † Per month. ‡ Per day.

cost of subsistence of such employés while traveling and in the field, &c.—Continued.

$75 OR MORE PER MONTH—Continued.

Subsistence.								
Meals en route.		Board.		Rations.		Total.		
Number.	Amount.	Days.	Amount.	Number.	Amount.	Days.	Amount.	
....	....	....	....	....	....	....	....	120
44	$34 75	6⅔	$13 50	89	$53 19	110⅓	$101 44	121
9	4 20	8½	10 50	....	....	11½	14 70	122
41	27 10	8½	11 41	112	34 00	134⅙	72 51	123
122	58 45	90⅔	129 04	....	....	131⅓	187 49	124
18	7 05	1½	4 00	46	13 38	53½	24 43	125
37	28 85	1	2 00	153	55 08	166⅓	85 93	126
33	24 75	15¼	13 00	152	57 76	178¼	95 51	127
48	30 55	12½	28 25	75	30 70	103½	89 50	128
23	15 50	153¼	307 49	....	....	160 11/12	322 99	129
....	....	....	....	....	....	....	....	130
4	1 00	....	....	46	13 38	47⅓	14 38	131
33	24 75	3½	7 00	153	55 08	167½	86 83	132
7	6 15	....	....	....	....	2⅓	6 15	133
4	3 00	2	5 00	....	....	3⅓	8 00	134
62	36 20	65¾	170 75	....	....	86 5/12	206 95	135
2	2 00	....	....	....	....	⅔	2 00	136
8	3 75	1	1 25	....	....	3⅔	5 00	137
20	5 95	89	71 45	51	20 16	146⅔	97 56	138
....	....	....	....	....	....	....	....	139
....	....	....	....	....	....	....	....	140
3	1 50	....	....	....	....	1	1 50	141
8	7 25	16¼	42 50	76	30 19	94 11/12	79 94	142
....	....	4½	12 12	....	....	4½	12 12	143
....	....	....	....	334	126 92	334	126 92	144
68	31 70	39½	73 63	....	....	62⅙	105 33	145
21	16 50	41¼	63 12	146	52 41	194¼	132 03	146
....	....	....	....	....	....	....	....	147
7	4 50	8	8 61	117	46 00	127⅓	59 11	148
2,756	1,728 79	3,208½	4,983 04	6,904	2,481 52	11,031⅙	9,193 35	

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[2] Salaried by United States Coast and Geodetic Survey.

[3] Salaried by Navy Department.

III.—TEMPORARY FORCE.

[Receiving less than $75 per month.]

3	$1 50	27¾	$55 50	21	$3 91	49¾	$60 91	1
11	6 40	12¼	22 87	54	21 48	69 11/12	50 75	2
....	....	2	3 00	....	....	2	3 00	3
108	48 90	134½	166 94	....	....	170½	215 84	4
14	6 56	6	7 23	196	75 04	206⅔	88 83	5
....	....	....	....	10	3 46	10	3 46	6
43	35 84	7¼	20 50	212	73 47	233 7/12	129 81	7
....	....	....	....	165	59 24	165	59 24	8
....	....	31	35 12	37	11 39	68	46 51	9
20	14 75	39	62 00	89	27 33	134⅔	104 08	10
....	....	½	1 00	194	74 10	194½	75 10	11

Amounts paid to employés of the United States Geological Survey for services and the

III.—TEMPORARY FORCE RECEIVING

	Name.	Employment.	Where employed.	Salary.		
				Rate.	Time.	Amount.
12	Andrews, E. H	Skilled laborer	Ariz., N. Mex., Va., and D. C.	*$720 00	359 d	$708 31
13	Atkinson, A	Rodman	New Jersey	†26 00 †60 00	64 d	57 55
14	Adatagé	Packer	Wis., Mich., and Minn.	‡2 00	27 d	54 00
15	Avery, L. B	Field assistant	Wisconsin			
16	Barbour, R. C	do	New Haven, Conn	†50 00	10 m	500 00
17	Bostwick, T. A	do	do	†70 00 *840 00	9 m	630 00
18	Barnes, E. E	Watchman	District of Columbia	*600 00 ‡2 00	8 m	435 03
19	Baldwin, H. L	Asst. topographer	Arizona	*720 00	343 d	676 71
20	Barbour, James, jr	Field assistant	Mass. and D. C	†40 00 †50 00	289 d	438 37
21	Brace, W. C	do	Massachusetts	†50 00	1 m	50 00
22	Boyé, Herbert C	Asst. topographer	do	†50 00	2 m	100 00
23	Burns, M. T	Field assistant	Va. and D. C	†55 00	302 d	546 45
24	Baden, Chas. C	Topographic asst.	California and Nevada.	†35 00 †50 00 ‡1 50	163 d	230 00
25	Bradbury, L. G	Cook	Yellowstone Park	†45 00	103 d	150 97
26	Brown, Geo. H	do	Texas	†30 00	249 d	245 35
27	Butt, P	Guide	Ariz. and N. Mex	‡1 50	24 d	36 00
28	Bradley, Jas. F	Cook	do	†55 00	115 d	200 80
29	Burgess, F	Packer	do	†50 00	32 d	51 60
30	Bell, W. S	Barometrician	Kansas	†40 00	36 d	46 96
31	Boatright, L. B	Axman	Texas	†30 00	31 d	30 00
32	Blackston, Edw'd	Cook	do	†30 00	196 d	192 76
33	Brown, Gaston	do	N. C., S. C., and Ga	†30 00	129 d	126 77
34	Boler, John	do	W. Va. and Ky	†30 00	3 m	90 00
35	Burnett, Jno. L	Field assistant	Tennessee	†60 00	94 d	184 47
36	Barnard, E. C	Asst. topographer	W. Va., Ky., and D. C	*720 00	340 d	671 14
37	Blackburn, D. W. R.	Barometric aid	California	†25 00 †30 00 †35 00	115½ d.	115 61
38	Boyce, Fred. C	Cook	do	†55 00	115½ d.	209 82
39	Brown, Samuel	Fireman	District of Columbia	*600 00 *480 00	154 d	232 62
40	Brown, William	Teamster	Va. and W. Va			
41	Brown, C. W	Draughtsman	District of Columbia	‡2 75	14 d	38 50
42	Bevier, P. H	Asst. topographer	New Jersey	†65 00	65 d	138 66
43	Blackburn, E. M	do	District of Columbia	*600 00 *720 00	4 m	238 69
44	Birge, E. A	Field assistant	Wis., Mich. and Mo			
45	Brenham, E. M	Skilled laborer	District of Columbia	‡3 00	48 d	144 00
46	Buell, Ira M	Field assistant	Wis. and Iowa	‡4 00	75⅞ d	303 50
47	Bassett, C. C	Asst. topographer	Mass. and D. C	*720 00	1 y	720 00
48	Burns, Frank	Asst. geologist	Fla., Miss., and Ala	†50 00	1 y	600 00
49	Benweir, N	Interpreter	Dakota	†60 00 †70 00	77 d	174 86
50	Bryant, Mary	Charwoman	District of Columbia	*180 00	9 m	134 80
51	Bennett, F. W	Asst. topographer	New Jersey	†65 00	342 d	731 78
52	Boyle, C. B	Temp'y assistant	Va. and W. Va	‡2 00	276 d	552 00
53	Barnes, C. H	Cook	Va. and D. C	†30 00	46 d	45 48
54	Burcheil, A. L	Rodman	do	†50 00	6 d	10 00
55	Bayne, B	Teamster	do	†35 00	46 d	53 06
56	Brighton, M. M	Laborer	District of Columbia	‡2 00	127 d	254 00
57	Bush, L. P	do	New Haven, Conn	†50 00	6 m	300 00
58	Barrett, Jack	do	Mississippi	‡75	3 d	2 25
59	Brooks, E. W	Field assistant	Wis. and Iowa			
60	Branch, Uriah	Cook	Dakota	†50 00	24 d	38 70
61	Cloud, Swift	Guide	do			
62	Crider, J. N	Teamster	Texas	†30 00	105 d	102 58
63	Crider, M. M	Axman	do	†30 00	61 d	58 58
64	Clawson, J. J	Packer	Ariz. and N. Mex	†55 00	162 d	290 96
65	Cockrell, John	Laborer	District of Columbia	*720 00	289 d	569 67
66	Chase, D. E	do	do	*480 00	9 m	359 60
67	Conway, A. P	Field assistant	Tennessee	†30 00	4 m	120 00
68	Crist, T. J	Teamster	do	†40 00	139 d	181 93
69	Cook, Charles E	Field assistant	Tenn., Ga., Ala., and D. C.	†40 00 †50 00	328 d	522 25

* Per annum. † Per month. ‡ Per day.

cost of subsistence of such employés while traveling and in the field, &c.—Continued.

LESS THAN $75 PER MONTH—Continued.

Subsistence.								
Meals en route.		Board.		Rations.		Total.		
Number.	Amount.	Days.	Amount.	Number.	Amount.	Days.	Amount.	
12	$3 65	34¾	$50 66			38¾	$54 31	12
50	14 91	44¼	47 39			60 11/12	62 30	13
				27	$7 85	27	7 85	14
1	50	1	3 00			1⅓	3 50	15
								16
								17
								18
21	15 20	½	1 75	153	58 33	160½	75 28	19
13	7 15	126⅓	131 15			130⅔	138 30	20
		22½	21 57			22½	21 57	21
133	38 24	11¾	13 65			56 1/12	51 89	22
7	3 95	24¾	27 37	55	21 61	82 1/12	52 93	23
		44	60 41	110	33 41	154	93 82	24
				103	37 08	103	37 08	25
				249	89 39	249	89 39	26
				24	9 12	24	9 12	27
				85	32 30	85	32 30	28
				32	12 16	32	12 16	29
				36	15 84	36	15 84	30
				31	11 13	31	11 13	31
				194	69 65	194	69 65	32
1	25			125	49 37	125⅓	49 62	33
4	1 75	12¼	9 50	74	29 34	87 7/12	40 59	34
9	5 00	10¼	12 79	77	30 38	90¼	48 17	35
12	4 70	11½	12 25	47	18 47	62½	35 42	36
				105	31 89	105	31 89	37
		1	1 75	142	43 27	143	45 02	38
								39
		21	19 56			21	19 56	40
								41
7	2 05	28¾	35 00			31 1/12	37 05	42
								43
10	6 50	3⅓	10 50			6⅔	17 00	44
								45
33	10 75	39½	34 35			50½	45 10	46
297	112 94	66¼	90 47			165¼	203 41	47
24	11 00	160 1/12	133 26			168 1/12	144 26	48
19	8 75			69	23 78	75⅓	32 53	49
								50
108	30 92	168¾	239 22			204¾	270 14	51
13	6 37	51⅙	68 55			55½	74 92	52
				45	16 96	45	16 96	53
				6	2 26	6	2 26	54
				45	16 96	45	16 96	55
		10	12 50			10	12 50	56
								57
								58
4	1 00	¼	50			1 7/12	1 50	59
				22	7 58	22	7 58	60
				6	2 07	6	2 07	61
				105	37 69	105	37 69	62
				61	21 90	61	21 90	63
				162	61 56	162	61 56	64
								65
								66
3	1 25	8¾	7 73	110	43 35	119¾	52 33	67
2	56	3	2 85	132	51 99	135⅔	55 40	68
12	5 87	10	16 00	100	39 43	114	61 30	69

Amounts paid to employés of the United States Geological Survey for services and the

III.—TEMPORARY FORCE RECEIVING

	Name.	Employment.	Where employed.	Salary.		
				Rate.	Time.	Amount.
70	Cudlipp, M. A	Field assistant	W. Va., Ky., and D. C	$†50 00	331 d	$545 16
71	Cort, W. H	...do	Massachusetts	†25 00	12 d	9 67
72	Chase, F. N	...do	...do	†50 00	127 d	208 06
73	Cummins, R. D	...do	Cal., Nev., Mass	†35 00 †45 00 †50 00	213 d	299 74
74	Copp, C. E	Messenger	District of Columbia	*480 00	75 d	99 57
75	Choate, C. D	Laborer	...do	*600 00 ‡2 00	359 d	593 50
76	Crowe, Joseph B	Skilled laborer	...do	*600 00	235 d	388 00
77	Chapman, R. H	Asst. topographer	Ariz. and N. Mex	*600 00 *720 00	1 y	718 09
78	Clark, E. B	Rodman	Mass. and D. C	†40 00	353 d	451 61
79	Covell, J. C	Barom. observer	West Virginia	†15 00	133 d	65 32
80	Clarke, E. P	Asst. chemist	Wisconsin	‡1 25	37½ d	46 88
81	Calvert, C. P	Draughtsman	District of Columbia	‡2 75	6 d	16 50
82	Childs, A	Laborer	Ala. and Miss	‡50	3 d	1 50
83	Callahan, E. D	Draughtsman	District of Columbia	‡2 00	6 d	12 00
84	Cariboo, D	Packer	Wis., Mich., & Minn	‡2 00	74¼ d	148 50
85	Crisp, H	Field assistant	Minnesota	‡2 00	3 d	6 00
86	Chaney, S. C	Packer	California	†40 00 †50 00 †55 00	115 d	184 33
87	Clark, J. J	Teamster	Cal. & Oreg	†55 00 †65 00	150 d	292 16
88	Carter, Cassius	...do	Colorado & Yel. Pk	†50 00 †75 00 ‡1 33⅓	183 d	314 54
89	Chase, H. S. (ensign, U. S. N.).[1]	Topographer	Yellowstone Park	....	......	....
90	Caldwell, Wm. A	Packer and teamster.	California	†25 00	1 m	25 00
91	Dunn, R. C	Teamster	Tenn., Ga., and Va	†30 00	2 m	60 00
92	Daniel, R. A	Axman	Texas	†30 00	49 d	48 38
93	Dunne, D. J[2]	Field assistant	Massachusetts	‡1 50	42 d	63 00
94	Dunn, D	...do	...do	....	......	....
95	Dallas, C. P	Laborer	District of Columbia	‡1 00	39 d	39 00
96	Day, Pleasant	Packer	Wisconsin	‡2 00	3 d	6 00
97	Dowens, Mike	Skilled miner	Mich., Wis., & Minn	‡2 00	1¾ d	3 50
98	Everett, C. F	Cook	California	†55 00	115 d	197 08
99	Ervin, J. F	Teamster	Colo. and Nev	†55 00 ‡1 50	189 d	295 71
100	Elliott, A. B	...do	Texas	†30 00	150 d	147 08
101	Elkins, J. M	...do	Virginia	†40 00	4 m	160 00
102	Emmert, John W	...do	N. C., S. C., and Ga	†40 00	147 d	192 22
103	Enigh, Jarvis	...do	Md., Va., and W. Va	†40 00	8 d	10 66
104	Earle, G. G	Rodman	New Jersey	†26 00	124 d	105 70
105	Erni, H	Laborer	District of Columbia	*720 00	319 d	628 97
106	Earchick, T	...do	Vermont	‡2 00	1⅖ d	2 80
107	Eagle, Spotted	Guide	Dakota	‡1 00	7 d	7 00
108	Flemming, W	Laborer	District of Columbia	‡1 25	7 d	8 75
109	Ford, S. W	Paleont. field asst	New York	†25 00	7 m	175 00
110	Frisbie, A. B	Laborer	District of Columbia	*600 00	1 y	600 00
111	French, G. H	Asst. topographer	California	....	......	....
112	Fitchen, G	Janitor	New York	†8 75	3 m	26 25
113	Ford, J	Packer	Ariz. and N. Mex	†55 00	137 d	246 61
114	Fitzgerald, W. R	...do	Arizona	†60 00	254 d	499 70
115	Farnsworth, Joe	Cook	...do	†55 00	144 d	259 04
116	Foot, S. A	Field assistant	W. Va., Ky., and D. C.	†40 00	348 d	458 06
117	Freyhold, Felix	Asst. topographer	Massachusetts	*720 00	128 d	250 54
118	Gibboney, Lizzie G	Barom. observer	Virginia	†15 00	48 d	23 71
119	Gallaher, T. K	Laborer	District of Columbia	‡1 35	26 d	35 10
120	Graham, H. A	Field assistant	D. C. and Mass	†40 00	231 d	304 51
121	Gorman, B	Carpenter	Yellowstone Park	†50 00	31 d	50 00
122	Gilmore, H. N	Herder	...do	†50 00	64 d	104 84
123	George, J. W	Cook	...do	†50 00	26 d	41 86
124	Garlick, C. A	Packer	Arizona	†60 00	62 d	120 00
125	Green, P. L	Field assistant	Texas	†50 00	343 d	564 50
126	George, P. S	...do	Md., Va., W. Va., D. C	†50 00	1 y	600 00
127	Green, Gassaway	Cook	Md., Va., and W. Va	†30 00	154 d	151 19
128	Goyther, William	...do	West Virginia	†30 00	48 d	46 45

* Per annum. † Per month. ‡ Per day.

cost of subsistence of such employés while traveling and in the field, &c.—Continued.

LESS THAN $75 PER MONTH—Continued.

Subsistence.								
Meals en route.		Board.		Rations.		Total.		
Number.	Amount.	Days.	Amount.	Number.	Amount.	Days.	Amount.	
10	$3 45	44	$36 67	74	$29 34	121⅓	$69 46	70
9	2 68	4¾	5 55	....	....	7¾	8 23	71
4	3 00	110	156 84	....	....	111⅓	159 84	72
2	1 50	128½	202 25	52	15 95	181⅙	219 70	73
....	....	....	....	....	....	....	....	74
....	....	....	....	....	....	....	....	75
....	....	....	....	....	....	....	....	76
27	19 50	....	....	145	55 10	154	74 60	77
68	33 25	140¼	218 39	....	....	162 11/12	251 64	78
....	....	....	....	....	....	....	....	79
16	5 25	12¾	13 37	....	....	18 1/12	18 62	80
....	....	....	....	....	....	....	....	81
....	....	....	....	....	....	....	....	82
....	....	....	....	....	....	....	....	83
2	75	....	....	73	21 24	73⅔	21 99	84
....	....	....	....	....	....	....	....	85
....	....	....	....	112	34 16	112	34 16	86
....	....	3	5 00	142	48 27	145	48 27	87
58	32 35	26¾	31 00	178	88 37	224 1/12	151 72	88
....	....	1⅓	2 50	105	36 39	106⅓	38 89	89
....	....	....	....	59	14 29	59	14 29	90
4	1 50	59	43 60	1	33	61⅓	45 49	91
....	....	....	....	49	17 59	49	17 59	92
....	....	56¼	63 88	....	....	56¼	63 88	93
....	....	19¾	25 96	....	....	19¾	25 96	94
....	....	....	....	....	....	....	....	95
....	....	....	....	3	87	3	87	96
....	....	....	....	....	....	....	....	97
....	....	....	....	[1]112	34 16	112	34 16	98
....	....	30	45 00	120	36 44	150	81 44	99
....	....	....	....	150	53 85	150	53 85	100
6	1 35	4¼	3 95	116	45 70	122¼	51 00	101
5	1 78	9½	9 00	126	49 51	137⅙	60 24	102
3	1 52	1	1 50	5	2 00	7	5 02	103
47	13 37	91¾	119 29	....	....	107 5/12	132 66	104
....	....	....	....	....	....	....	....	105
....	....	....	....	....	....	....	....	106
14	6 00	....	....	62	21 36	66⅔	27 36	107
....	....	....	....	....	....	....	....	108
....	....	....	....	....	....	....	....	109
....	....	....	....	....	....	....	....	110
....	....	....	....	29	[2]8 60	29	8 60	111
....	....	....	....	....	....	....	....	112
....	....	1¼	2 50	136	51 68	137¼	54 18	113
....	....	....	....	254	96 52	254	96 52	114
....	....	½	1 00	143	54 30	143½	55 30	115
13	5 30	37¾	29 56	85	33 40	127 1/12	68 26	116
3	2 80	90	104 56	....	....	91	107 36	117
....	....	....	....	....	....	....	....	118
....	....	....	....	....	....	....	....	119
4	2 95	133 11/12	149 88	....	....	135¼	152 83	120
....	....	....	....	31	10 74	31	10 74	121
....	....	....	....	64	22 18	64	22 18	122
....	....	....	....	26	9 01	26	9 01	123
....	....	....	....	62	23 56	62	23 56	124
20	13 75	33¾	58 99	149	53 59	189 5/12	126 33	125
9	3 80	5¼	9 12	77	30 20	85¼	43 12	126
3	1 40	3¼	5 25	147	57 70	151¼	64 35	127
5	1 70	6	5 50	39	15 32	46⅔	22 52	128

[1] Paid by Navy Department.

[2] Rainy days deducted from pay, but not board.

Amounts paid to employés of the United States Geological Survey for services and the

III.—TEMPORARY FORCE RECEIVING

	Name.	Employment.	Where employed.	Salary.		
				Rate.	Time.	Amount.
129	Giesy, S. H	Field assistant	N. C., S. C., and Ga	†$50 00	67 d	$109 24
130	Gore, C. B	do	Massachusetts	‡1 50	5½ d	8 25
131	Grambs, W. J	Asst. topographer	do	†50 00	44 d	72 58
132	Garcia, C. W. F	Fireman	Dist. of Columbia	*480 00 ‡1 33	140 d	185 70
133	Guild, E. L	Driver	Iowa			
134	Grinnell, W. L	Teamster	Virginia	†45 00	57 d	84 13
135	Grinnell, F. M	Cook	do	†43 00	57 d	84 13
136	Greene, J. W	Skilled laborer	District of Columbia	*720 00 ‡2 50	293 d	658 00
137	Giziz, Jim	Packer	Minnesota	‡2 00	3 d	6 00
138	Gibson, A. M	Collector	Alabama	†50 00	2 m	100 00
139	Gibb, H	Asst	Connecticut	†50 00	9 m	450 00
140	Geddes, G. M	Laborer	District of Columbia	*600 00	199 d	322 83
141	Howell, D. J	Asst. topographer	Mass., Va., and D. C	*720 00	337 d	665 27
142	Harvey, C. H	Barom. observer	Arizona	†30 00	95 d	93 88
143	Hess, W. Z	Cook	Kans. and Mo	†50 00	48 d	79 03
144	Hehe, H	Herder	Arizona	‡75	89 d	66 75
145	Holman, Paul	Asst. topographer	Ariz., N. Mex., D. C	*840 00	334 d	767 70
146	Hollowell, J. R	Cook	Yellowstone Park	†50 00	27 d	45 00
147	Henderson, Nellie	Barom. observer	do	†20 00	68 d	44 51
148	Henderson, H. S. T	Asst. topographer	California	‡1 50	19 d	28 50
149	Harrison, D. C	Field assistant	W. Va., Ky., and D. C	†60 00	344 d	679 35
150	Hamblin, Benj	Packer	Arizona and N. M	†55 00	144 d	259 04
151	Hooe, R. H	Field assistant	Virginia and D. C	†40 00	352½ d	429 02
152	Hackett, M.	Asst. topographer	Va., W. Va., D. C., Md	*600 00 *720 00	1 y	718 09
153	Hepburn, C. B	Field assistant	Mass., Kans., & Mo	†50 00	171 d	280 26
154	Hewett, C. H	do	Massachusetts	†40 00	2 m	80 00
155	Hunter, F. S	do	do	‡1 50 †40 00	98½ d	136 25
156	Hill, John E	Odomet. record	New Jersey	†39 00	119 d	151 93
157	Hawkins, G. T	Asst. topographer	Missouri and Kansas	*720 00	344 d	678 67
158	Hendley, J. P	Laborer	District of Columbia	*480 00	1 y	480 00
159	Hermann, A	Assistant	Connecticut	†65 00	9 m	585 00
160	Hammond, A. McF	Laborer	District of Columbia	‡1 50	146 d	219 00
161	Hilton, Louisa	do	do	‡1 25	98 d	122 50
162	Hough, E. P	Draughtsman	do	‡2 50	20 d	50 00
163	Howe, C. W	Rodman	Colorado			
164	Howe, A. S	Laboratory service	do	‡2 00	23 d	46 00
165	Hill, George	Asst. topographer	New Jersey	†65 00	343 d	734 53
166	Harvey, L	Copyist	California	*720 00	1 y	720 00
167	Howard, E. L	Laborer	District of Columbia	*480 00 *600 00	1 y	597 49
168	Hodges, J. W	Office janitor	Colorado	†10 00 †7 50	6 m	52 50
169	Horse, Yellow	Guide	Dakota			
170	Irwin, H. T	Field assistant	Virginia and D. C	†30 00 †45 00	163 d	219 67
171	Jennings, J. H	Asst. topographer	Massachusetts	*720 00	1 y	720 00
172	John, Hostin	Herder	Arizona and N. Mex	‡75	36 d	27 00
173	Johnson, J. M	Packer	do	†55 00	144 d	259 04
174	Jake, Navajo	Guide	Arizona	‡1 50	126 d	189 00
175	Jensen, A	Cook	California	†50 00	35 d	58 06
176	Jones, A. C	Janitor	Colorado	†5 00	326 d	53 75
177	Jake	Driver	Dakota			
178	Jaques, J	Draughtsman	New Jersey	†39 00 †45 00	52 d	72 68
179	Jingibiss	Packer	Michigan	‡2 00	27 d	54 00
180	Jeffries, W. F	Field assistant	Massachusetts	†50 00	146 d	238 71
181	Johnston, T. H	Barom. observer	North Carolina	†50 00	151½ d	247 58
182	Johnson, John	Fireman	District of Columbia	*600 00	169 d	279 84
183	Jackson, J. H	Teamster	Arizona	†30 00	31 d	30 00
184	Juan, Navajo Indian	Herder	do	†40 00	84 d	109 67
185	Jenkins, John	Teamster	Texas	†30 00	49 d	48 38
186	Johnson, Nephi	Packer	Arizona	†55 00	164 d	294 26
187	Kadorce, Peter	do	Minnesota	‡2 00	30½ d	61 00
188	Knerr, E. B	Field assistant	Virginia	†50 00	1 m	50 00
189	King, Nick	Skilled miner	Michigan	‡2 00	1¾ d	3 50
190	Kerr, R. C	Barom. assistant	California			
191	Kelly, Arthur	Temporary assist.	Colorado	†70 00	98 d	225 75
192	Key, J. J	Field assistant	Kansas	†50 00	102 d	166 93

*Per annum. †Per month. ‡Per day.

cost of subsistence of such employés while traveling and in the field, &c.—Continued.

LESS THAN $75 PER MONTH—Continued.

Subsistence.								
Meals en route.		Board.		Rations.		Total.		
Number.	Amount.	Days.	Amount.	Number.	Amount.	Days.	Amount.	
9	$4 75	13	$16 85	46	$18 00	62	$39 60	129
1	50	4	7 00			4⅓	7 50	130
38	15 46	30¾	50 60			43 5/12	66 06	131
								132
		¾	1 50			¾	1 50	133
1	25	3¼	6 50	53	23 70	56 7/12	30 45	134
1	25	3¼	6 50	53	23 70	56 7/12	30 45	135
								136
								137
								138
								139
								140
24	12 23	134 7/12	148 50	45	16 96	187 7/12	177 69	141
		87	87 00	8	3 04	95	90 04	142
				48	18 24	48	18 24	143
				89	33 82	89	33 82	144
33	27 75	13½	5 25	283	104 45	307½	137 45	145
				27	9 72	27	9 72	146
				68	23 57	68	23 57	147
		15	16 12			15	16 12	148
10	3 95	33	26 10	91	35 75	127⅓	65 80	149
		½	1 00	143	54 30	143½	55 30	150
4	2 75	81	80 76	53	20 80	135⅓	104 31	151
19	5 27	39¼	49 40	107	42 00	152 7/12	96 67	152
118	49 76	47¼	64 53	77	33 88	163 7/12	148 17	153
		25	50 00			25	50 00	154
3	75	7¾	8 25			8¾	9 00	155
60	16 15	87	130 30			107	146 45	156
13	8 25	13¼	19 88	76	33 50	93 7/12	61 63	157
								158
								159
								160
								161
								162
3	1 50					1	1 50	163
								164
105	30 72	150½	181 22			185½	211 94	165
								166
		¾	1 25			¾	1 25	167
								168
11	4 50			63	21 71	66⅔	26 21	169
1	75	45¼	43 00	83	32 60	128 7/12	76 35	170
19	5 98	290½	360 31			296⅚	366 29	171
				36	13 68	36	13 68	172
		½	1 00	143	54 30	143½	55 30	173
				126	47 88	126	47 88	174
				33	10 00	33	10 00	175
								176
				22	7 59	22	7 59	177
9	4 00	15¼	19 75			18¼	23 75	178
				27	7 85	27	7 85	179
237	88 76	33¼	43 00			112¼	131 76	180
7	4 50	110¾	58 92	16	6 30	129 1/12	69 72	181
								182
		13¾	14 38	17	6 10	30¾	20 48	183
				84	31 92	84	31 92	184
				49	17 59	49	17 59	185
				164	62 32	164	62 32	186
3	1 50	1¾	3 50	27	7 85	29¾	12 85	187
								188
								189
2	1 00			29	8 71	29⅔	9 71	190
								191
13	9 10	13¼	19 87	72	31 70	89 7/12	60 67	192

Amounts paid to employés of the United States Geological Survey for services and th

III.—TEMPORARY FORCE RECEIVIN

	Name.	Employment.	Where employed.	Salary.		
				Rate.	Time.	Amount.
193	Lewis, J	Laborer.	Vermont	‡$2 00	5 d	$10 00
194	Libby, E	Skilled miner	Mich., Minn., & Wis.	‡2 00	1 d	2 00
195	Lynas, William	Driver	Virginia and W. Va.	‡50	10 d	5 00
196	Leslie, Ida M	Copyist	District of Columbia.	‡2 00	53 d	106 00
197	Luster, W. H	Odom. recorder	New Jersey	†26 00 †39 00	191 d	202 16
198	Lane, W. B	Teamster	N.C., Va., W. Va., Md.	†40 00 †50 00	228 d	322 20
199	Lovell, W. H	Field assistant	Massachusetts	†45 00	61 d	90 00
200	Lincoln, J. D	do	W. Va. and Ky	†40 00	132 d	172 90
201	Leonard, H. S	do	Virginia	†50 00	48 d	77 41
202	La Point, F	Packer	California	‡2 00 †55 00	39¾ d	74 50
203	Lucas, G. B	Barom. observer	Texas	†25 00	111 d	90 83
204	Lawrence, Edward	Cook	Arizona	†30 00	48 d	47 41
205	Laughrey, C. D	do	Montana	‡2 00	35 d	70 00
206	Lewis, W E	Skilled laborer	District of Columbia	†60 00	195 d	386 00
207	Munroe, H	Messenger	do	*480 00	49 d	63 88
208	Money, G. P	Rodman	Va. and D. C	†50 00	2 m	100 00
209	McKee, George R	Cook	Colorado	†50 00	112 d	182 20
210	Monillerat, Frank	Packer	Yellowstone Park	†45 00	10 d	15 00
211	Murray, J. J	Teamster	do	†60 00	138 d	270 70
212	Miller, Frank L	General assistant	California	‡1 00	19 d	19 00
213	Mundon, George A	Cook	Yellowstone Park	†50 00	83 d	147 55
214	Meyer, John	do	do	†50 00	10 d	16 67
215	Morrison, John	Packer	Minnesota	‡2 00	80 d	160 00
216	Matteson, Howard	Cook	Yellowstone Park	†50 00	19 d	31 66
217	Moran, John	do	Arizona	†50 00	58 d	93 81
218	Mitchell, Robert	Packer	do	†50 00 †60 00	84 d	157 10
219	McLaren, Charles	Cook	California	†50 00 †55 00	109 d	190 79
220	McBride, John F	Packer	do			
221	Murlin, A. E	Asst. topographer.	Tennessee and D. C	*600 03 *720 00	1 y	718 09
222	McCall, Fred	Teamster	Georgia and Ala	†30 00 †40 00	112 d	130 32
223	Michler, R. McC	Asst. topographer	N. C., S. C., Ga., D. C.	*720 00	347 d	684 83
224	McCormack, David	Field assistant	Massachusetts	†36 00	62 d	73 20
225	Manning. VanH., jr.	Assistant	do	†50 00	2 m	100 00
226	McKee, Redick H	Field assistant	District of Columbia.	†60 00	349 d	689 03
227	Moorhead, Anna S	Draughtsman	do	‡2 00	196 d	392 00
228	Milan, John	Laboratory asst.	California	†25 00	37 d	30 00
229	Mason, Anthony	Watchman	District of Columbia.	*600 00 *720 00	1 y	718 09
230	Manore, Joseph	Quarryman	Vermont	‡2 50 *480 00	33 d	46 70
231	Mayer, W. J	Assistant	Connecticut	†50 00	3 m	150 00
232	Marvine, W. F	Draughtsman	New Jersey	†26 00	215 d	183 38
233	Manchester, J. E	Assistant	Minnesota	‡1 33⅓	66 d	88 00
234	Martin, John H	Skilled laborer	Wisconsin	‡2 00	1 d	2 00
235	Morrison, Paul	Packer	Minnesota	‡2 00	27 d	54 00
236	Metcalf, W. N	Assistant	Wisconsin			
237	Mulien, Edith V	Copyist	District of Columbia	*600 00	1 y	600 00
238	Müller, Bruno	Skilled laborer	do	‡1 00 ‡2 00	160 d	295 00
239	McElhone, E. V.	Asst. topographer	do	*720 00	1 y	720 00
240	Norton, John	Cook	California	†50 00	35 d	58 06
241	Newman, W. G	Asst. topographer	W. Va., Ky., & D. C	*600 00 *720 00	4 m	248 47
242	Norris, George B	Field assistant	Ala. and Tenn	†18 00	1 m	18 00
243	Niblack, W. A	Asst. topographer	Virginia and D. C	†50 00	300 d	493 54
244	Nemask, Wash. F	Packer	Minnesota	‡2 00	3 d	6 00
245	Neher, C. H	Field assistant	New Jersey	‡2 00	6 d	12 00
246	O'Reilly, Andrew	Teleg. operator	Missouri and Kans	†10 00	2 m	20 00
247	Oyster, Edward A	Asst. topographer	Virginia and D. C	*600 00 *720 00	1 y	718 09
248	O'Connell, Wm. J	Skilled laborer	Va., W. Va., and D.C.	‡2 00 *600 00	228 d	405 70
249	Phillips, R. H	Asst. topographer	Massachusetts	*720 00	196 d	384 91
250	Pedro, Zuñi Indian	Night herder	Arizona	‡2 00	3 n	6 00
251	Picket, G. R[1]	Barom. assistant	California		29 d	

* Per annum. † Per month. ‡ Per day.

cost of subsistence of such employés while traveling and in the field, &c.—Continued.

LESS THAN $75 PER MONTH—Continued.

Subsistence.								
Meals en route.		Board.		Rations.		Total.		
Number.	Amount.	Days.	Amount.	Number.	Amount.	Days.	Amount.	
								193
								194
4	$1 50	7⅔	$7 86			9	$9 36	195
								196
83	19 58	137⅙	188 02			164⅚	207 60	197
6	3 00	8¾	14 50	142	$55 79	152¾	73 29	198
		31	62 00			31	62 00	199
13	4 55	21¾	18 00	94	36 90	120 1/12	59 45	200
1	50	5¼	5 25	33	13 00	38 7/12	18 75	201
		7	5 50	40	12 15	47	17 65	202
								203
				48	17 23	48	17 23	204
				35	16 16	35	16 16	205
								206
								207
				45	16 96	45	16 96	208
				61	24 23	61	24 23	209
				10	3 46	10	3 46	210
		3	4 50	141	54 18	144	58 68	211
		16	16 12			16	16 12	212
		½	50	83	22 77	83½	23 27	213
				10	3 46	10	3 46	214
6	3 00	1¾	3 50	73	21 24	76¾	27 74	215
				19	6 84	19	6 84	216
				58	22 04	58	22 04	217
				84	31 92	84	31 92	218
		3	4 50	142	43 10	145	47 60	219
				29	8 71	29	8 71	220
9	4 40	43½	35 61	81	31 82	127½	71 83	221
6	1 13	1	50	106	41 66	109	43 29	222
8	4 75	5¼	6 02	123	48 30	130 11/12	59 07	223
		12	14 49			12	14 49	224
58	22 94	20½	34 00			39⅚	56 94	225
8	6 40	120	192 84			122⅔	199 24	226
								227
								228
								229
								230
								231
67	19 05	126	171 12			148⅓	190 17	232
9	2 88	4	5 75	52	15 13	59	23 76	233
								234
				27	7 85	27	7 85	235
23	10 43	15	24 88			22⅔	35 31	236
								237
								238
								239
				33	10 00	33	10 00	240
5	2 50	98¾	86 06			100 5/12	88 56	241
1	50	1½	1 75	24	9 40	25⅚	11 65	242
23	9 34	20	30 69	70	27 50	97⅔	67 53	243
				3	87	3	87	244
1	40	1¾	2 33			2 1/12	2 73	245
								246
7	3 65	19¼	23 25	85	33 40	106 7/12	60 30	247
1	50			1	39	1⅓	89	248
388	150 54	53¾	59 73			183 1/12	210 27	249
				3	1 14	3	1 14	250
				29	8 71	29	8 71	251

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[1] Services gratuitous during June by special contract.

Amounts paid to employés of the United States Geological Survey for services and t

III.—TEMPORARY FORCE RECEIVIN

	Name.	Employment.	Where employed.	Salary.		
				Rate per annum.	Time.	Amount.
252	Phillips, G. B	Teamster	California	....	29 d	....
253	Porter, George E	Packer	New Mexico	†$50 00	26 d	$43 33
254	Pipkin, S. P	do	do	†40 00	18 d	24 00
255	Price, J. F	Axman	Texas	†30 00	41 d	40 00
256	Patterson, C. P	Cook	Tenn., Ga., and Ala	†30 00	3 m	90 00
257	Peterson, Henry	Packer	Yellowstone Park	†45 00	10 d	15 00
258	Polleys, Thomas	Copyist	Wisconsin	§20	881 h	176 20
259	Peterson, Jane	Charwoman	District of Columbia	*180 00	1 y	180 00
260	Payne, A. C	Odometer recorder	New Jersey	†39 00	63 d	79 93
261	Phillips, J	Draughtsman	Wisconsin	§20	146 h	29 20
262	Pohlers, G. F	do	District of Columbia	†50 00	37 d	59 67
263	Perkins, E. T., jr	Asst. topographer	Arizona	*720 00	192 d	375 10
264	Quackenbush, E. C	Laborer	Yellowstone Park	†60 00	40 d	79 35
265	Robinson, A. R	Cook	Texas	†30 00	70 d	70 35
266	Rockwell, H. D	Laborer	Yellowstone Park	†40 00	101 d	131 60
267	Roeser, F	Asst. topographer	Massachusetts	*720 00	137 d	285 74
268	Robinson, E. D	Field assistant	do	†30 00 †50 00	74 d	109 87
269	Rivers, C. M	Barom. observer	Kansas	†20 00	88 d	57 74
270	Ray, William	Packer	California	†50 00 †65 00	120 d	215 74
271	Rabe, Carl	Geological aid	do	*600 00	10 m	499 50
272	Reynolds, H. L., jr	Asst. topographer	District of Columbia	*300 00 *720 00	1 y	713 20
273	Reynolds, J. B	Rodman	New Jersey	†26 00 †45 00 †60 00	70½ d	66 61
274	Roll, Israel	Cook	Tenn. and Ga	†25 00	21 d	16 93
275	Ruff, L. F	Odometer recorder	New Jersey	†39 00	47 d	59 13
276	Reed, W. M	Asst. topographer	District of Columbia	*600 00 *720 00	31 d	58 69
277	Routh, Madeleine D	Translator	do	*720 00	2 m	120 70
278	Ribenock, George	Laborer	Mich. and Wis	§25	77 h	19 25
279	Rouser, Marshall	do	District of Columbia	‡1 00 ‡1 25	31 d	34 25
280	Redman, Bob	do	Mississippi	‡50	3 d	1 50
281	Reifenerg, Marie	Charwoman	Connecticut	‡50	15 d	7 50
282	Spangler, George	Collector	Vermont	†50 00	2 m	100 00
283	Simms, George	Laborer	Mississippi	‡75	3 d	2 25
284	Smith, W. F	do	Connecticut	‡1 00	1 d	1 00
285	Sproul, C. F	Asst. topographer	New Jersey	†65 00	318½ d	676 04
286	Sheridan, C. F	Cook	Yellowstone Park	†40 00	47 d	61 07
287	Sullivan, C. E	Teamster	Tenn., N. C., Ga., Va	†30 00	163 d	159 67
288	Salander, W. B	Packer	Yellowstone Park	†50 00	10 d	16 67
289	Selden, H. S	Asst. topographer	N. C., S. C., Ga., D. C	*600 00 *720 00	1 y	718 09
290	Sharp, John T	Teamster	Colorado	†45 00	105 d	153 85
291	Smith, William B	Temp. assistant	do	†70 00	1 y	840 00
292	Schonfarber, S	Clerk	do	*840 00	261 d	599 70
293	Schrader, E	Janitor	do	†10 00	6 m	60 00
294	Sisson, Belle H	Barom. observer	California	†30 00	1 m	30 00
295	Sadlemire, W. S	Packer	Yellowstone Park	†45 00 †50 00 †60 00	117 d	209 83
296	Stein, Robert	Stenographer	District of Columbia	‡2 00	263 d	526 00
297	Silva, Antonio	Cook	California	....	....	....
298	Smith, T. A	Teamster	New Mexico	‡2 00	10 d	20 00
299	Smithson, W. L	do	W. Va. and Ky	†40 00	135 d	179 35
300	Sudlow, Charles	Field assistant	Yellowstone Park	†25 00	20 d	16 67
301	Smith, William	Cook	Arizona	†30 00	32 d	30 98
302	Smith, John	do	Texas	†30 00	171 d	168 38
303	Stewart, Brigham	Packer	Arizona	†55 00	45 d	81 50
304	Simpson, H. C	Cook	do	†25 00	92 d	75 57
305	Shepler, C. V	do	do	†30 00	82 d	80 68
306	Schmelzkopf, E	do	do	†50 00	43 d	69 35
307	Smyth, H. L	Field assistant	Massachusetts	†50 00	43 d	70 54
308	Scriver, S	do	do	†10 00	2 m	20 00
309	Sayles, C. S	do	Tenn. and W. Va	†40 00	221 d	289 03
310	Sulio, Jos	Packer and cook	Mich., Miss., and Wis	‡1 75	7 d	12 25
311	Smith, E. S	Skilled laborer	District of Columbia	‡2 00 ‡2 50	66½ d	163 75
312	Staats, P. D	Odometer recorder	New Jersey	†55 00	350 d	633 88

*Per annum. †Per month. ‡Per day. §Per hour.

ost of subsistence of such employés while traveling and in the field, &c.—Continued.

LESS THAN $75 PER MONTH—Continued.

Subsistence.								
Meals en route.		Board.		Rations.		Total.		
Number.	Amount.	Days.	Amount.	Number.	Amount.	Days.	Amount.	
....	....	....	....	29	$8 71	29	$8 71	252
....	....	....	....	26	15 95	26	15 95	253
....	....	....	....	18	10 58	18	10 58	254
....	....	....	....	41	14 72	41	14 72	255
2	$0 63	1	$0 50	87	34 18	88⅔	35 31	256
....	....	....	....	10	3 46	10	3 46	257
....	....	....	....	....	....	....	....	258
....	....	....	....	....	....	....	....	259
40	12 11	33⅓	42 18	....	....	46⅔	54 29	260
....	....	....	....	....	....	....	....	261
....	....	....	....	....	....	....	....	262
30	22 50	8½	6 00	154	58 52	172½	87 02	263
7	5 50	4	10 00	28	9 70	34⅓	25 20	264
....	....	....	....	70	25 18	70	25 18	265
25	19 60	0⅓	50	....	....	8⅔	20 10	266
8	4 85	138¾	160 90	....	....	141 5/12	165 75	267
106	47 94	30¼	39 17	....	....	65 7/12	87 11	268
....	....	....	....	....	....	....	....	269
....	....	....	....	120	36 44	120	236 44	270
....	....	....	....	....	....	....	....	271
....	....	....	....	....	....	....	....	272
30	9 76	44¼	51 26	....	....	54¼	61 02	273
....	....	....	....	19	7 46	19	7 46	274
35	11 30	32½	26 27	....	....	44⅙	37 57	275
....	....	....	....	....	....	....	....	276
....	....	....	....	....	....	....	....	277
....	....	....	....	....	....	....	....	278
....	....	....	....	....	....	....	....	279
....	....	....	....	....	....	....	....	280
....	....	....	....	....	....	....	....	281
....	....	....	....	....	....	....	....	282
....	....	....	....	....	....	....	....	283
....	....	....	....	....	....	....	....	284
85	25 45	90⅔	116 28	....	....	119	141 73	285
....	....	....	....	47	17 29	47	17 29	286
16	5 53	158¼	134 47	....	....	163 7/12	140 00	287
....	....	....	....	10	3 46	10	3 46	288
8	4 50	20½	15 02	115	45 20	138⅙	64 72	289
....	....	....	....	92	36 56	92	36 56	290
38	22 20	....	....	92	36 56	104⅔	58 76	291
29	22 00	2	6 50	....	....	11⅔	28 50	292
....	....	....	....	....	....	....	....	293
....	....	....	....	....	....	....	....	294
....	....	....	....	117	42 12	117	42 12	295
....	....	....	....	....	....	....	....	296
....	....	....	....	29	8 71	29	8 71	297
....	....	....	....	10	5 87	10	5 87	298
10	3 95	18¾	19 96	113	44 50	135 1/12	68 41	299
....	....	....	....	20	6 94	20	6 94	300
....	....	....	....	82	11 49	82	11 49	301
....	....	....	....	171	61 39	171	61 39	302
....	....	0½	1 00	44	16 72	44½	17 72	303
....	....	....	....	92	40 48	92	40 48	304
....	....	....	....	82	36 08	82	36 08	305
....	....	....	....	43	16 34	43	16 34	306
43	15 42	23⅓	35 10	....	....	37⅔	50 52	307
....	....	....	....	....	....	....	....	308
33	12 05	170½	148 75	....	....	181½	160 80	309
....	....	....	....	7	2 04	7	2 04	310
....	....	....	....	....	....	....	....	311
128	29	190	239 55	....	....	231⅓	268 59	312

Amounts paid to employés of the United States Geological Survey for services and the

III.—TEMPORARY FORCE RECEIVING

	Name.	Employment.	Where employed.	Salary.		
				Rate.	Time.	Amount.
313	Tingley, A. O	Laborer	District of Columbia.	*$480 00	296 d.	$390 00
314	Thomas, W	Porter	New Jersey	†3 00 †3 40 †3 60 ‡50	142 d	24 00
315	Thomson, J. R	Draughtsman	Wisconsin	§20	71 h.	14 20
316	Tait, J. G	Rodman	New Jersey	†26 00	2 m.	52 00
317	Trowbridge, E. R[1]	Teamst. and pack.	California	†50 00	11 m.	549 99
318	Tulley, Steven	Packer	California & Nevada.	†55 00	39 d.	72 70
319	Thompson, L. L	Field assistant	Colorado	†70 00	89 d.	203 00
320	Tilton, S. E	Camp assistant	do	†45 00	5 d.	7 25
321	Towson, R. M	Asst. topographer	Tenn., Ga., Ala., D.C.	*720 00	11 m.	659 41
322	Thompson, W. J	Packer	Yellowstone Park	†60 00	10 d.	20 00
323	Turner, Granville	do	do	†65 00	10 d.	21 67
324	Thompson, William	do	do	†67 00	94 d.	205 29
325	Van Hook, Charles G	Field assistant	Md., Va., W. Va., D.C	†40 00	348 d.	458 06
326	Von Dachenhausen, F. W.	Asst. draughtsman.	District of Columbia	*600 00	121 d.	200 00
327	Van Disst, E. C	Field assistant	Colorado	†35 00	71 d.	80 50
328	Von Brakle, Frank	Rodman	New Jersey	†26 00 †60 00	74½ d.	71 26
329	Vermeule, Adrian	do	do	†26 00	15 d.	13 00
330	Vasseur, Josef	Packer	Minnesota	‡1 00	7 d.	7 00
331	Watson, Thomas	do	California	†55 00	89 d.	161 55
332	Warren, Bentley W.	Laborer	Yellowstone Park	†40 00	101 d.	131 60
333	Walsh, W. M	Draftsman	Dist. of Columbia	‡2 50	3 d.	7 50
334	Wines, William	Skilled laborer	Dist. of Columbia	‡2 50 *720 00	255 d.	563 00
335	Wallingsford, W. M.	Laborer	Dist. of Columbia	‡1 60	75 d	120 00
336	White, Joseph	Cook and packer	Wis., Mich., and Minn	†35 00	38½ d.	43 10
337	Willpart, Rich	Field assistant	Massachusetts	†36 00	9 d.	10 80
338	Wylie, C. C	do	Yellowstone Park	†25 00	20 d.	16 67
339	Walters, E. K	do	Colorado	†45 00	71 d.	103 50
340	Ware, Jane L	Charwoman	Dist. of Columbia	*180 00	1 y.	180 00
341	Warren, Dwight P	Cook	Ariz. and N. Mex	†50 00	147 d.	240 30
342	Wallace, George	do	Arizona	†50 00	91 d.	150 00
343	Wilson, S. J	Asst. topographer	N. C., S. C., Ga., and Dist. of Columbia.	*600 00 *720 00	1 y.	708 65
344	Walker, W. T	Teamster	Missouri and Kansas	†30 00 †35 00	95 d	103 85
345	Willmunder, E	Packer	Arizona	†50 00	51 d.	85 45
346	Wilkin, C. H	Teamster	Kansas and Missouri	†30 00	84 d.	82 68
347	Washington, B. C., jr.	Astronomic assist.	do	†40 00	289 d.	420 65
348	Ward, Philip A	Cook	Virginia	†30 00	131 d.	128 70
349	Withers, L	Teamster	Tennessee and District of Columbia.	†40 00	354 d.	465 80
350	Youk, Ah	Cook	Yellowstone Park	†50 00	24 d.	40 00
351	Yaste, W. J	Laborer	District of Columbia.	*600 00	109 d.	181 32
352	Young, A. A	Field assistant	Wisconsin	‡2 00	4¼ d.	8 50
353	Various temporary assistants.					
	Aggregate					69,068 56

* Per annum. † Per month. ‡ Per day. § Per hour.

Cost of subsistence of such employés while traveling and in the field, &c.—Continued.

LESS THAN $75 PER MONTH—Continued.

Subsistence.								
Meals en route.		Board.		Rations.		Total.		
Number.	Amount.	Days.	Amount.	Number.	Amount.	Days.	Amount.	
								313
								314
								315
18	$5 90	36⅛	$47 28			42⅛	$53 18	316
3	1 45	4	7 50	359	$70 09	364	79 04	317
				40	12 15	40	12 15	318
22	18 00			87	34 56	94⅓	52 56	319
				5	1 48	5	1 48	320
21	8 05	29½	41 45	84	33 01	120½	82 51	321
				10	3 46	10	3 46	322
				10	3 46	10	3 46	323
		0⅓	50	94	32 68	94⅓	33 18	324
4	1 65	11¾	14 75	121	47 68	134 1/12	64 08	325
								326
		0¼	75	92	36 56	92¼	37 31	327
50	16 06	25	28 39			41⅔	44 45	328
5	2 15	11½	16 75			13⅙	18 90	329
				7	1 83	7	1 83	330
				82	24 90	82	24 90	331
28	21 60	0⅓	50	101	35 00	110⅔	57 10	332
								333
								334
								335
6	1 50			46	13 38	48	14 88	336
								337
				20	6 94	20	6 94	338
6	8 00			92	36 56	94	44 56	339
								340
				147	55 86	147	55 86	341
				91	54 58	91	54 58	342
11	4 94	63 7/12	74 56	93	36 80	160¼	116 30	343
				95	41 80	95	41 80	344
				51	19 38	51	19 38	345
				84	36 96	84	36 96	346
24	17 00	145⅜	286 18			153⅜	303 18	347
2	1 00	2⅔	2 63	129	50 70	132⅓	54 33	348
9	3 81	1¾	3 00	134	52 68	138¾	59 49	349
				24	8 33	24	8 33	350
								351
								352
29	12 96	10	16 65			19⅔	29 61	353
8,703	1,536 43	5,639⅝	6,923 81	14,294	5,259 59	21,168⅓	13,719 83	

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[1] Worked one month without pay; subsisted himself in part (though the records do not show it), whereby the number of rations is excessive and the ration rate is too low.

Cost of subsistence of employés of the United States Geological Survey, in diff

TABLE IV.

	Division.	Where employed.	Meals en route.		
			Number.	Total cost.	Mean cost.
1	New England division of topography.	Massachusetts	2,225	$908 31	$0 41
2	New Jersey division of topography.	New Jersey	1,055	329 00	31
3	Appalachian division of topography.	Md., W. Va., Va., Ky., Tenn., N. C., S. C., Ga., Ala., and D. C.	598	263 11	44
4	Appalachian division of geology	Virginia, West Virginia, Tennessee, and North Carolina.	291	134 54	46
5	Division of quaternary geology	Upper Mississippi Valley	462	222 46	48
6	Western district of archean geology.	Minnesota, Wisconsin, and Michigan.	129	64 10	50
7	Missouri-Kansas section of topography.	Missouri and Kansas	118	79 45	68
8	Texas section of topography	Texas	110	80 55	73
9	Yellowstone and Montana division of geology.	Montana and Wyoming	345	261 89	76
10	Yellowstone division of topography.	Yellowstone National Park	187	154 00	82
11	Rocky Mountain division of geology.	Colorado and D. C	230	214 70	67
12	Arizona section of topography.	Arizona and New Mexico	307	241 20	79
13	California division of geology.	California	203	129 25	64
14	Cascade division of topography and geology.	California, Nevada, and Oregon	395	265 75	67

TABLE V.—*Hotel expenses of members of the United States Geological Survey who are paid under the legislative appropriation bill, when traveling on Government business from July* 1, 1884, *to June* 30, 1885.

Names.	Amounts.
C. C. Darwin	$13 40
J. K. Hillers	1 00
J. D. McChesney	28 00
J. C. Pilling	13 20
J. W. Powell	80 30
J. J. Stevenson	39 40
Total	175 30

ent portions of the United States, during the fiscal year ending June 30, 1885.

TABLE IV.

Board.			Rations.			Cost of ration at customary prices.	
Days.	Total cost.	Mean cost.	Number.	Total cost.	Mean cost.		
2, 560	$3, 327 56	$1 30	....	....	....	....	1
1, 413	1, 830 14	1 29	....	....	....	....	2
1, 888	1, 978 84	1 05	5, 171	$2, 035 67	$0 39	$0 45	3
619	698 38	1 12	339	135 76	40	45	4
333	562 00	1 69	54	30 34	56	....	5
59	133 87	2 27	741	215 56	29	48	6
364	670 45	1 84	746	328 46	44	44	7
170	279 18	1 64	2, 416	867 65	36	44	8
72	211 25	2 95	1, 775	653 25	37	54	9
40	104 00	2 60	1, 520	521 87	34	54	10
161	315 50	1 96	1, 045	415 21	40	53	11
232	318 30	1 37	4, 531	1, 698 71	37	51	12
232	481 00	2 07	838	155 88	19	50	13
429	657 25	1 53	2, 762	838 99	30	50	14

LETTER OF PROF. J. W. POWELL, DIRECTOR OF THE GEOLOGICAL SURVEY.

DEPARTMENT OF THE INTERIOR,
UNITED STATES GEOLOGICAL SURVEY,
Washington, D. C., February 26, 1886.

Hon. WILLIAM B. ALLISON,
Chairman, &c.:

SIR: In the printed testimony presented to the Commission considering the organization of certain scientific bureaus of the Government, presided over by yourself, there appears a letter from Mr. Alexander Agassiz relating to the work of the Geological Survey which is a censure of its administration and a condemnation of its existence as a governmental institution. The statements themselves might have little influence if their only force was derived from their intrinsic merit or axiomatic truth; then, indeed, no refutation would be necessary. But their power depends upon the re-enforcement they receive from the great name of Agassiz. The present advanced state of scientific research in America is partly the result of the inspiration of the elder Agassiz, who gave generous encouragement to scientific investigation in every possible field and by every possible agency, for his genius was so vast as to include a clear comprehension of many methods by which the progress of science contributes to the progress of civilization. That the name of Agassiz should be appended to a sweeping disapproval of the great system of research prosecuted by the Geological Survey is to place upon all that work the brand of condemnation. I am impelled by these considerations to invoke the indulgence of yourself and of the commission over which you preside, that a criticism of Mr. Agassiz's statements may be made and placed on record in the same body of testimony.

STATEMENT OF MR. AGASSIZ'S POSITION.

A careful examination of the letter in question reveals the fact that the charges therein contained are not clearly and specifically formulated, but the letter is rather one of general denunciation. Under such circumstances it is somewhat difficult to make reply; for, as different constructions may be put upon the statements, there is a possibility that a reply to any particular construction may be open to the objection that it does not meet the case, from the fact that some other charge was intended.

It will be noted that the investigations in the Comstock, Eureka, and Leadville districts are condemned. Now, the work in these regions consisted (1) of topography, as careful and elaborate maps were made of the several districts; (2) of structural geology, as the general geology of the districts and their relations geologically to the surrounding country were carefully and thoroughly investigated; (3) of paleontology, as the fossiliferous rocks were investigated; (4) of lithology, as the rocks were studied chemically and microscopically; (5) the nature of the ore-beds was investigated, together with the relations of these ore-beds to the structural geology and the lithology of the districts; and (6) an endeavor was made to derive from this investigation general principles relating to the origin and occurrence of ore-bodies, that might be of value to all mining industries relating to gold, silver, and their associate metals. It is not clear whether Mr. Agassiz condemns all of this investigation or a part only. It may be implied that he condemns the entire work as being of such a character that the agents of the Government should not engage therein.

Elsewhere Mr. Agassiz affirms that paleontology is a branch of geologic science in which the Government should not engage, and in affirming that a proper geologic map cannot be made without the groundwork of a topographic map and further suggesting that the General Government should not provide such topographic map, he gives strength to the inference that he condemns all the geologic work of the United States Survey, including its topography, general geology, mining geology, and paleontology. Thus it seems to be the general intent and purpose of the letter to condemn the entire work of the Survey as being of a character which should not be prosecuted by the General Government, but only by private individuals and institutions, and further he seems to affirm that private parties would be quite willing to do this work if only the General Government would withdraw therefrom.

That such is indeed the meaning of Mr. Agassiz is not quite plain. It may be that it was his intention simply to disapprove of the policy of making thorough and comprehensive surveys of the three districts mentioned. Perhaps his approval would have been given to the work if it had been distributed over larger areas in districts of country not characterized by the occurrence of great ore-bodies. That is, it may be that he designs to condemn geologic investigation when it has for its ultimate purpose the development of industrial utilities.

It may be that it was designed to condemn simply that part of the investigation and discussion by which it was sought to apply the facts and principles discovered to economic purposes.

It seems that any one of these three interpretations may be put upon the letter, and each one must be answered.

(1) DOES THE GENERAL WORK OF THE GEOLOGICAL SURVEY FALL WITHIN THE LIMITS OF INDIVIDUAL INVESTIGATION AS ITS EXCLUSIVE PROVINCE?

In reply to this question a brief comparison of what the General Government and the State governments have done for geologic research with the work accomplished by private enterprise will be significant.

For a long term of years the General Government has provided for general topographic and geologic surveys with various purposes in view and under various organizations.

It is not possible at the present time to fully and accurately state the cost of this work, but it is certain that it has been considerably more than $6,000,000. There have resulted therefrom great numbers of maps, some of small districts, others of large areas. Some of the maps have been such rough work as to have but an ephemeral value; others have been made with care, and have permanent value. In addition to the topography thus characterized, a large number of geologic reports have been published, including works on general geology, mining geology, and paleontology.

A hundred years ago the present system of land surveys for the parceling of unoccupied tracts was organized. The plan adopted was not the result of accident, but was very carefully considered for a series of years by able statesmen and engineers, inspired and guided by Thomas Jefferson, and it was proposed that a most thorough survey should be made of the public lands. For this reason the plan included not only an accurate parceling of the lands, but also such a survey as would constitute a proper basis for all cadastral maps. It was also designed to be a proper topographic survey which should subserve all industrial and military purposes; and later in the history of the country, under the leadership of Lewis Cass, a geologic survey was ingrafted upon the system, and a series of eminent geologists were employed to do the work. The plan, so comprehensive and wise, was adopted after careful investigation and deliberation, and had it been executed according to the original intent, the country would now have completed by far the greatest and most important geographic survey on the face of the globe. Unfortunately, one vicious principle was early incorporated in the plan, viz, that the work should be given out under contract, not to the lowest bidder, but to preferred bidders, a method which resulted in great extravagance on the one hand and such a deterioration of the work upon the other that it finally subserved but the single purpose of parceling the lands. Since the organization of these surveys up to the present time $35,000,000 have been expended therefor, and it will always be a matter of profound regret to scholars and statesmen that the grand purposes for which the surveys were primarily organized were not fully realized. These facts are recalled in this connection simply to illustrate the statement that topographic surveying has been recognized as the proper work of the General Government ever since the adoption of the Constitution and geologic surveying ever since the development of the science.

Again, many of the States have provided for topographic and geologic surveys. The amount thus expended under State appropriations has been more than $4,000,000. The geologic surveys have produced many maps, on varying scales and with varying degrees of excellence, and the reports thereon, including the subjects of general geology, mining geology, and paleontology, have been very numerous. It thus appears that the General Government and the State governments together have expended large sums of money in this field, more than $10,000,000, and that for all this outlay there has been a very large return in publications, altogether constituting a great library of scientific information.

I have no knowledge of any case where private institutions, such as colleges or societies, have undertaken to do field work in topography and geology.

To some slight extent individuals—notably some able college professors—have made geologic excursions in the field, and accumulated valuable material, and the contributions thus made to the science of geology are of great importance, but altogether their proportions are very small when compared with the great works accomplished by the official surveys above mentioned.

Topographic and geologic surveying has been the work of the General

Government and of the State governments, and in Europe such work has always been governmental.

It may be well next to consider the agencies for the publication of topographic and geologic work. There have been no original topographic maps published by private enterprise worthy the mention, except those of the Transcontinental Survey, a work cut short in its early stages by the withdrawal of support. The publication of original topography has been almost wholly governmental, but the publication of original general geology, mining geology, and paleontology has been divided between governmental and private agencies. Still, it must be noted that a large part of the geologic publication has been official, and but a small part private. The material published by private agencies appears chiefly in the transactions of societies and in the scientific journals; and, in respect of its origin, is of two classes, viz: (1) publication of materials collected by private persons and (2) publication of materials collected by official geologists. The smaller part is of the first class, the larger part of the second.

Official geologists are constantly making discoveries of new fossils, new minerals, new rocks, new bodies of ore, new structural characteristics, or they are constantly proposing new explanations, and announcements of these discoveries and hypotheses are made through the scientific journals and in transactions of societies.

A part of the publications through the scientific journals is controversial, and a still larger part is a rediscussion of the facts and principles set forth in official reports. It thus happens that the non-official publications, with a very few important exceptions, are exceedingly fragmental and imperfect; in fact, very much of this publication is erroneous because it is hasty.

The principal monographic works—the great systematic treatises on geology and paleontology—are official. Those great works, which have cost years of labor and have enduring value, are, with some very few exceptions, the reports published by the General and State Governments.

There is another important fact in this connection, namely: to properly publish paleontology and lithology, engravings are necessary; verbal descriptions are imperfect because it is impossible to fully convey the facts in words without the use of figures. Scientific publication in this field depends upon graphic illustration, and mere verbal description is everywhere condemned by scientific men as being nearly or quite valueless. In the same manner, structural and economic geology can be published only by the aid of maps and diagrams, and here also mere verbal publication is always imperfect and to a large extent without value. Now, there is a great contrast between the official and the private publications in all these respects. In the official publications graphic illustration has generally been full and good. In the private publications, with the few exceptions previously mentioned, the graphic illustration has been meager and of low grade.

With these facts clearly understood, the following tables will not be misleading. They are designed to show simply the quantity of the official publications as compared with the private publications, this quantity being measured by pages of text and plates of illustration. The tables have necessarily been hastily prepared from the material in the library of the Geological Survey. They do not represent the entire body of publication, but only the larger part of it, yet it is believed that they fairly give the ratio of official to private matter. It must be further noted that some discrimination has been necessary in the selection of material to be classed under private publication, but a generous leniency respecting its scientific character has been made, though a large amount has been taken from reports on private property that do not rise much above the grade of advertisements, and whose value to the public is rendered doubtful by their *ex parte* character.

It is safe to assert that of the 120,000 pages of general geology taken into consideration not more than about 6,000 are the direct and independent results of private investigation, and of the total information conveyed by the geologic maps enumerated not 5 per cent. is the result of independent private investigation. In the enumeration no instance has been found of the systematic investigation of any considerable area—such, for example, as the Comstock, Eureka, or Leadville district—by any private party, corporation, or non-governmental organization of any kind. So far as the examination has extended, all thoroughgoing systematic geologic investigation of any areal extent has been done by governmental aid.

Table comparing the amount of governmental with the amount of private publication of general geology.

	Gov.	Private.
Pages of general geology	105, 775	15, 139
Geologic maps	551	126

Table comparing the amount of governmental with the amount of private publication of paleontology in the United States.

	No. of pages.		No. of plates.	
	Gov.	Private.	Gov.	Private.
Vertebrates	4, 343	3, 491	650	285
Invertebrates	10, 955	10, 076	1, 728	458
Plants	2, 853	349	480	26
Total	18, 151	13, 916	2, 858	769

(2) WERE THE COMSTOCK, EUREKA, AND LEADVILLE DISTRICTS UNWISELY SELECTED AS THE SUBJECTS FOR THOROUGH INVESTIGATION?

It may be that Mr. Agassiz, in his condemnation of the work in these districts, referred chiefly to the fact that the work was concentrated in them rather than distributed more generally elsewhere, and that it was not his purpose to condemn geologic work at large. If such was the case, his statement must have been made with little consideration of the facts. From these three districts more than 444 millions of gold and silver bullion have been taken and hundreds of miles of shafts and galleries have been constructed. There were therefore three important reasons controlling the judgment of the Director in planning this work. The first reason was the industrial importance of these districts. All geologic investigation is directly or ultimately of economic importance, and the vast industries gathered in these three districts urgently demanded the attention of scientific men. The second reason existed in the fact that the extensive underground workings revealed facts on a large scale which otherwise could not have been discovered. The third reason existed in the fact that these shafts and galleries would not long remain open and accessible to the geologist, as, when no longer used, they become impassable. Under these circumstances it would have been folly to neglect a field of research so promising, so fertile, and so important to the industries of the country until it was too late. And finally the Director believes that he has full warrant for the assertion that the publications on these three important districts are great contributions to geologic science, and to that branch most immediately connected with those mining industries which produce the metals that are the basis of the currency of the world.

(3) IS ECONOMIC GEOLOGY UNWORTHY OF THE PATRONAGE OF THE GENERAL GOVERNMENT?

Perhaps Mr. Agassiz only intended to condemn the applied science developed in the three great works at Virginia City, Eureka, and Leadville. To this it may be replied that the organic act of the Geological Survey requires such work. The purpose for which the Geological Survey is organized is not to develop science at large, but to develop that branch of science which relates to one class of the great industries of the country in order that industry may be the gainer thereby. As the law requires that economic work should be done, and as the primary function of the Geological Survey is the performance of work having a utilitarian end, it would seem that what has been done was in obedience to the law and in fulfillment of its purpose.

It is hardly appropriate to present to statesmen an argument in favor of the importance of directing scientific research to purposes of industrial utility. There is a sentiment current among ignorant men that profound science is incompatible with practical business, and this arises from the fact that it is difficult to demonstrate the immediate and direct utilitarian purpose of scientific investigation. It is often that such results are not proximate, but only ultimate. When the ignorant challenge the learned for the "practical," or "economic," or "utilitarian" value of their knowledge, the answer is not always rendered in terms within the comprehension of the questioner, and he scoffs at all answers that he cannot understand. Now, there are narrow and dilettante scientists who retort that science is too exalted to be in any manner interested in utilitarian results, and sometimes these wiseacres boast of their devotion to "pure science." But great scientific men, like great statesmen and great men in all departments of society, clearly recognize the fact that knowledge is a boon in itself and in its utilitarian consequences alike—that wisdom is exalting and knowledge is power.

SHOULD THE GENERAL GOVERNMENT SUPPLY THE PEOPLE WITH A TOPOGRAPHIC MAP OF THE COUNTRY?

Certain more specific allegations of the letter need reply. Mr. Agassiz says:

> It is an impossible thing to make a good geologic map of the country without having as a groundwork a good topographical map of the country.

In this statement Mr. Agassiz exhibits a knowledge of the subject under consideration not manifest in his other statements, and hence he occupies high ground; but on that pinnacle of truth he becomes vertiginous and falls into the error of saying that "if the States are not willing to go to that expense, it seems plain that they do not wish the Government to go to that expense for them," thus by implication asserting that the people do not want a topographic map of the country.

The representatives of the people in Congress assembled have provided for a topographic map of the United States, and it is reasonable to suppose that the statesmen of the country fairly represent public opinion.

But many of the States have engaged in the same enterprise.

New Hampshire has completed a topographic survey of that State; Massachusetts has at different times expended much money in this work, and is now engaged in making a map of the territory of the commonwealth in conjunction with the Geological Survey. It is understood that Mr. Agassiz himself has urged upon the legislature of Massachusetts the importance of a topographic survey of that State. The State of New York has appropriated large sums of money for the triangulation and topography of that State. New Jersey has appropriated large sums of money for a topographic survey, and at the request of the State authorities the survey of that State is being completed by the United States Geological Survey. Pennsylvania has appropriated large sums of money for a topographic survey, and the State authorities have asked the officers of the United States Geological Survey to aid in its completion. Virginia, in its early history, provided for a topographic survey. North Carolina has provided for topographic surveying. The same is true of Kentucky, Missouri, Illinois, Michigan, Wisconsin, and California, and, further, the public men of every State and Territory of the United States are interested in the topographic work of the Geological Survey now in progress, are striving to promote its vigorous execution, and everywhere urging that the work be commenced in the several States and Territories.

It is evident that if this geographic work is delayed until Mr. Agassiz believes that the people want it, it will die.

ARE THE PUBLICATIONS OF THE SURVEY WORTHLESS?

Again, Mr. Agassiz says:

"There is no end to that kind of interesting documents which the heads of bureaus could get printed at Government expense, and which very few individuals or societies would print even had they the means at their command;" and elsewhere he says that "private individuals have learned nothing" from a large class of the reports of the Survey.

There is thus published to the American people that a large corps of men, believed by the public to be eminent scholars and high authority in their several branches of research, are but pretenders. King, Hague, Emmons, Gilbert, Dutton, Becker, Hayden, Chamberlin, Irving, Shaler, McGee, Davis, Peale, and many other eminent geologists; Marsh, White, Walcott, Dall, Ward, Fontaine, Lesquereux, Newberry, and other eminent paleontologists; Clarke, Gooch, Chatard, and other eminent chemists; Gannett, A. H. Thompson, Gilbert Thompson, Woodward, and other eminent geographers and topographers, are all involved in this wholesale condemnation, and the Director of the Survey himself is, by implication, published as the chief of pretenders. Every one of the gentlemen whose names are mentioned has borne an active, distinguished, and, it has been heretofore supposed an honorable part in American scientific research. Their contributions to science constitute a library of knowledge, and have been given to the world with the sanction of the Government of the United States and of the several States; and the scientific journals of America and of the world have been filled with their writings and embellished with their scholarship, and human knowledge has been largely increased thereby. The names of these men are forever engraved in the literature of the country, and their discoveries are taught in every institution of learning in the land, from the university to the public school. It is not fitting, even by association, that the name of Agassiz the Great should be appended to the defamation of such men.

ARE THE EDITIONS OF REPORTS TOO GREAT?

Again, Mr. Agassiz says:

> The methods of publication adopted by the various bureaus, the mode of distribution, the size of the editions, are wasteful and extravagant. Editions running into the thousands and tens of thousands are often published, and there are not five hundred people or institutions whom they will do any good, or to whom such pure scientific publications can be of any service.

There is a sentiment, rarely found in America but more common in Europe, that would exclude the people at large from a knowledge of the progress of scientific research. In the lands where this sentiment has its home it is desired to establish, in emulation of the hereditary aristocracies, scientific aristocracies, which, it is claimed, should also have official recognition.

In Europe this sentiment has lent its aid to the policy of publishing very small editions of great scientific works, but the policy has not generally been adopted in America, because the sentiment has gained no foothold in this land of free institutions. The scientific reports published by the General Government and by the State governments have been in large editions, that they might be scattered broadcast through the libraries of the country. The Director of the Geological Survey has long been of the opinion that the time will soon come when all of the scientific publications of the General Government, including those of the Geological Survey, the Coast and Geodetic Survey, the Meteorological Service, the Astronomical Service, the Fish Commission, the National Museum, and the Smithsonian Institution, will be distributed to one or more public libraries in every county of the United States. This is imperatively demanded, in order to secure a wise and just distribution among the people of the sources of advancing knowledge.

SHOULD THE RESULTS OF THE INVESTIGATIONS OF THE SURVEY BE INTRUSTED TO PRIVATE AGENCIES FOR PUBLICATION?

It may possibly be inferred from Mr. Agassiz's letter that he does not condemn the general researches prosecuted by the Geological Survey, but only disapproves of the publication of the results by the General Government, on the theory that individuals and private institutions should be intrusted with the publication, for he says: "It will always be possible for specialists to write such memoirs, and if they are properly qualified they will find no difficulty in having access to all of the information obtained by government officials of the Geological Survey;" and elsewhere in the letter Mr. Agassiz cites his own publication of "fourteen volumes quarto, with many plates, and three volumes octavo," the materials for which were collected by the United States Coast Survey. It may be stated that Mr. Agassiz has also published scientific works the materials for which were collected by State surveys and by private individuals. Mr. Agassiz has devoted many years to the accumulation of a great fortune, and has used the means acquired by successful business operations for the publication of scientific books and the promotion of scientific research. It is understood to have been his plan to create by gigantic business enterprises a great fund to be used for such purposes; and that it has been his ambition to make the museum over which he presides the American center of scientific research, and the agency which should create, control, and diffuse the increasing knowledge of the New World. A plan so vast was worthy of a great mind, and perhaps Mr. Agassiz would have carried it to completion had it been a possible achievement for any one man. Due honor should be accorded to him for the brilliancy of his unrealized scheme; but far more honor should be accorded him for that which he has actually accomplished in giving his private wealth to the museum at Cambridge and in publishing the works to which reference has already been made; but a hundred millionaires could not do the work in scientific research now done by the General Government; and shall the work of scientific research and the progress of American civilization wait until the contagion of his example shall inspire a hundred millionaires to engage in like good works? Before that time comes scientific research will be well endowed by the people of the United States in the exercise of their wisdom and in the confident belief that knowledge is for the welfare of all the people. If the General Government should do the work and pay for it from the public treasury, all that results from the expenditure should be given back to the people at large through the agencies of the public libraries which they have established. To turn over all of this material to private societies or museums for publication would be to defraud the people of that for which their money is expended. On examining the publications included in the list given to the Commission by Mr. Agassiz it will appear that they are based upon materials collected by the General Government, at great expense, and the elaboration of these materials for publication was made partly at the expense of the Government, partly by private institutions, partly by Mr. Agassiz himself, partly by volunteer assistants, and partly by persons in the employ of foreign governments. It also appears from Mr. Agassiz's letter that the Superintendent of the Coast Survey himself believed that these should be published by the Government, and in this he was clearly right. In this connection it is worthy of remark that Mr. Agassiz's principal work in research has been published by the British Government.

WHAT SCIENTIFIC RESEARCHES SHOULD THE GOVERNMENT ENDOW?

And again Mr. Agassiz says:

> In fact, I do not see why men of science should ask more than other branches of knowledge, literature, fine arts, &c., beyond the limitations I had suggested of Government assistance.

In this statement and in the general tenor of the letter there is involved a consideration of the extent to which Government should promote scientific research by endowment and the field in which such researches should be conducted.

On this general subject I have already spoken to the Commission, and its members have, in the exercise of much patience, listened to the imperfect exposition which I have been able to make, yet I beg to be indulged in a restatement of certain principles.

(1) THE GOVERNMENT SHOULD NOT UNDERTAKE TO PROMOTE RESEARCH IN THOSE FIELDS WHERE PRIVATE ENTERPRISE MAY BE RELIED UPON FOR GOOD AND EXHAUSTIVE WORK, ESPECIALLY WHILE VAST FIELDS WHERE PRIVATE ENTERPRISE CANNOT WORK ARE STILL UNOCCUPIED BY THE AGENTS OF THE GOVERNMENT.

Mr. Agassiz seems to have adopted this principle, and then by some strange mischance used it to exclude the work of the Geological Survey from the operations to be carried on under the Government, failing to understand, as the facts here presented show, that topographic and geologic surveying must be carried on by governments, or be so feebly prosecuted as to be of little value.

(2) IT WOULD SEEM TO BE WISDOM ON THE PART OF A GOVERNMENT DESIGNED TO PROMOTE THE WELFARE OF THE PEOPLE TO PROVIDE FOR INVESTIGATIONS IN THOSE FIELDS MOST VITALLY AFFECTING THE GREAT INDUSTRIES IN WHICH THE PEOPLE ENGAGE.

The annual output of the mines of the United States aggregates in value about $425,000,000, and it seems probable that it will equal $1,000,000,000 by the end of the century, and these mining industries are interdependent with all the other industries of the country.

But the economic results of the Survey are by no means confined to mining industries. Agricultural industries also are largely benefited thereby. It is investigating the flood-plain valleys of the great rivers, like that of the Mississippi, for the purpose of determining the conditions under which they can be redeemed. It is investigating the conditions under which the great arid regions may be most economically fertilized by irrigation. It is also investigating the conditions under which the great coast marshes and interior swamps may be drained and utilized. All these investigations bear directly upon the agricultural development of the country.

There is another consideration in this connection the importance of which can scarcely be estimated. There can never be any thorough or largely-valuable investigation made of the soils of the country until a topographic map and also a geologic map of the country are constructed. The soils are surface accumulations derived by atmospheric disintegration from the indurated formations lying beneath. The organic law of the Geological Survey makes it its duty to classify these soils, and therefore to enter upon the investigation necessary thereto, but such investigation cannot be properly inaugurated until maps are constructed. When this field of investigation is properly cultivated, the Geological Survey will be related to all the agricultural interests of the country as well as to all its mining industries.

Again, the Geological Survey, in the prosecution of its topographic work, is constructing a map of all the forests of the country. It is thus related to all the lumber industries.

Again, in the study of the structural geology of the country, it is steadily revealing the conditions under which artesian waters may be discovered, and prognosticating the areas where artesian wells may be constructed. Its work in this field alone is full compensation for its entire cost.

Again, in its investigation of the interior hydrography of the country, it is developing the conditions and means by which the towns and cities of the country may obtain a proper supply of healthful water. The calls upon the Survey for information on this subject are many and rapidly multiplying.

Again, in the construction of the topographic map of the United States, it is developing a knowledge of the natural routes for the high-ways of commerce, and its work in this field is of gigantic proportions, and the information obtained is distributed to all of the people. The work of the Survey is thus related to the internal commerce of the country.

Altogether, the Geological Survey has practical relations with all the industries of the people, and is pre-eminently designed to promote the welfare of the people.

(3) ONE NATIONAL SURVEY IS MORE EFFICIENT AND ECONOMIC THAN MANY STATE SURVEYS.

In all the primary operations of civilization there is a steadily increasing division of labor and a steadily-increasing integration by the organization of labor through the assumption of operative functions by governments and the establishment of corporations by private individuals. It is a great characteristic of modern civilization that the work of the individual, when divorced from that of others, is futile and inconsequent, but that it steadily becomes influential and efficient as it becomes properly related to the work of others, so as to form an integral part of the operations of some body politic. This organization of labor is the essential condition for the advancement of civilization everywhere recognized by statesmen, publicists, and the men who control all important industrial operations.

The same principle applies with even greater force to the operations of scientific research. This can be clearly illustrated in the organization of the Geological Survey of the United States, and in the operations of geologic research everywhere throughout the world. The great departments of geology are differentiated not only in treatises on general geology, but in the very operations of research themselves. Take, for example, the single department of paleontology. There is now nowhere in the world a paleontologist of such genius that he accomplishes efficient work in the whole field of paleontology, but the subject-matter of this department of science is divided on a biologic basis into vegetal paleontology and animal paleontology. Animal paleontology is again subdivided into the four departments having to do severally with the vertebrates, articulates, mollusks, and radiates. Then, each of these great classes of animals has appeared on the globe, from time to time along the course of its history, and the individual paleontologist usually takes up some one such restricted class, as it appeared in some restricted part of geologic time, and makes that the subject of his investigations and contributions to knowledge. It thus becomes impossible to conduct a thoroughly comprehensive and symmetrical survey without having the field of research divided into many branches, each one of which is cultivated by some specialist whose work becomes an integral part in the body of systematic results.

It is for this reason that the minor units of government, such as municipalities, counties, and States are unable properly to organize geologic research, and hence it becomes necessary for the General Government to undertake the work. In the several State geologic surveys which have herotofore been organized, some special department of geology only has been taken up. One State has devoted its resources chiefly to some branch of paleontology. Thus New York, which has expended about $700,000 in its geological survey, has devoted itself mainly to invertebrate paleontology; Pennsylvania, which has expended an equal amount of money, has devoted itself largely (though not exclusively) to the geology of coal and iron; and like illustrations may be drawn from every State survey. No comprehensive State survey has ever been organized, nor has it been possible, from the fact that an organization of a multiplicity of specialists was necessary therefor.

In the light of this statement, the elaborate organization existing in the United States Geological Survey, as it has already been set forth to the Commission, is justified; for if any part of its organization were to be cut off, the field represented thereby would be neglected, and all other work, in whatever field, would be injured.

(4) THE PLANT FOR GEOLOGIC INVESTIGATION IS TOO EXPENSIVE FOR PRIVATE AGENCIES.

With the progress of research the tools with which it is accomplished are steadily becoming more numerous, more complex, and more expensive—that is, there is steady development in the instruments and appliances of research represented in observatories, laboratories, and libraries. The time has already arrived when the private individual can no longer engage in productive investigation in many of the fields of science unless he is possessed of great wealth. And shall the genius of only the wealthy be employed in advancing the boundaries of human knowledge, and does great wealth invariably inspire its possessors with love for research, insight into Nature's laws, and patience in long labor?

(5) THE RESULTS OF LOCAL INVESTIGATION ARE OF GENERAL VALUE TO MANY DISTRICTS, AND A KNOWLEDGE OF THE GEOLOGY OF ONE LOCALITY MUST BE DERIVED FROM AN EXAMINATION OF MANY OTHER LOCALITIES.

The geology of a continent is, in an important respect, a unit. There is a structural interdependence of parts, so that the geology of one district is not properly understood until the geology of other districts related thereto has been set forth. For this reason State geologists, in order to clearly understand the problems arising in their own States, are often compelled to extend their researches far beyond the State boundaries by which they are inclosed. Thus, in the Geological Survey of the State of New York, the State geologist has found it necessary to collect fossils and to study geologic structure in more than a dozen of the States of the Union, because the geologic formations discovered in New York extend widely throughout the country, and to properly understand their relations wide excursions were necessary.

During the past year Professor Pumpelly, of the Geological Survey, has been engaged in the study of certain geologic formations in New England. During this winter his field of operations has been transferred to Northern Georgia, from the fact that the same problems are presented in this region, and by the study of a new field much additional information may be obtained of direct interest to the New England work.

A discovery at St. Johns, New Brunswick, another on Lake Superior, another in the Grand Cañon of the Colorado, another in Texas, and another in Tennessee are found to be intimately related, and the facts in no one of these districts can be properly understood, except through the light thrown upon them by the facts in the other districts.

This interdependence of facts and principles existing in geologic research makes it important that a survey should be organized upon the broadest territorial basis possible, and one such integrated organization can accomplish far greater results than a score could accomplish with the same amount of money divided among them.

(6) ALL GOVERNMENTAL RESEARCH STIMULATES, PROMOTES, AND GUIDES PRIVATE RESEARCH.

Possession of property is exclusive; possession of knowledge is not exclusive; for the knowledge which one man has may also be the possession of another. The learning of one man does not subtract from the learning of another, as if there were a limited quantity to be divided into exclusive holdings; so discovery by one man does not inhibit discovery by another, as if there were a limited quantity of unknown truth. Intellectual activity does not compete with other intellectual activity for exclusive possession of truth; scholarship breeds scholarship, wisdom breeds wisdom, discovery breeds discovery. Property may be divided into exclusive ownership for utilization and preservation. but knowledge is utilized and preserved by multiple ownership. That which one man gains by discovery is a gain of other men. And these multiple gains become invested capital, the interest on which is all paid to every owner, and the revenue of new discovery is boundless. It may be wrong to take another's man's purse, but it is always right to take another man's knowledge, and it is the highest virtue to promote another man's investigation. The laws of political economy that relate to property do not belong to the economics of science and intellectual progress. While ownership of property precludes other ownership of the same, ownership of knowledge promotes other ownership of the same, and when research is properly organized every man's work is an aid to every other man's.

Let these doctrines be applied to the work of the Geological Survey. Suppose there was a good topographic map of every county in the United States, and that in every county there was a library of the official reports on the geology of the country. There would thus be distributed to every community the materials which constitute the foundation of geologic science, and the geology of each county would constitute an illustration of these principles and facts. Every college in the land would thus have accessible to its professors and students the practical materials and means by which to obtain an objective as well as theoretical knowledge of the subject, and the students of such a college could at once be introduced to the study in such a manner that they could become observers and collectors. This is not an ideal or optimistic consideration, for many college professors with their students are engaged in practical field studies of this character and utilizing the best materials at their command prepared by the geologists of the General Government or by State geologists; and many of the leading colleges are urging the Geological Survey to execute local work in their immediate neighborhoods in order that such surveys may be available for college instruction. All of our high schools in the cities and towns of the land might be benefited in like manner.

Everywhere throughout the United States local scientific societies are organized from time to time, all of which would be benefited in the manner above stated, and such societies would multiply rapidly if there was such a topographic and geologic survey of the country already accomplished that its materials could be used for their purpose. Scattered widely throughout the country there are many young men pursuing studies, many professional men, such as civil engineers and physicians, and many men of scholarship in all walks of life, who are becoming more and more interested in scientific subjects and who need but the practical means and opportunities for research which such a survey would give, in order that they may become practical field geolo-

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